Homewood Mountain Resort Ski Area Master Plan Project

Cumulative Watershed Effects Analysis

Review Draft

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for the

Tahoe Regional Planning Agency

EXECUTIVE SUMMARY

Cumulative Watershed Effects (CWE) Model

CWE Overview

Integrated Environmental Restoration Services (IERS), in collaboration with Dr. Mark Grismer (UC Davis Hydrology and Environmental Engineering) completed the HMR Cumulative Watershed Effects (CWE) analysis for the Project area watersheds following the approach outlined in the TRPA's Ski Area Master Plan Guidelines (TRPA 1990) with guidance from TRPA Staff. Appendix 5 of the Ski Area Master Plan Guidelines outlines the requirements for preparation of a CWE analysis. The HMR CWE analysis assists in the planning for and understanding of the cumulative impacts of redevelopment within the Project area, especially as they relate to sediment movement and water quality. These Project area findings have been combined with sediment movement and water quality findings for the total watersheds for a more complete understanding of impacts and areas of influence.

A CWE analysis is a qualitative evaluation of the overall health of a watershed and which provides an insight into the sensitivity of the watershed to disturbances such as land use development and redevelopment. The analysis includes a qualitative evaluation of a watershed that is supported by quantitative modeled parameters. The purpose of the HMR CWE analysis is to estimate the relative impacts caused by facilities or activities related to past and proposed development and to determine appropriate mitigation if necessary.

Thresholds of Concern (TOC)

The HMR CWE analysis evaluates the relative impacts of the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6 as compared to existing conditions (No Project or Alternative 2) and Thresholds of Concern (TOCs). TOCs are conceptual thresholds that describe a point beyond which a relatively irreversible trend of increasing degradation to 'beneficial uses' may occur. The TOC concept is roughly analogous to the TRPA Environmental Thresholds and the ecological concept of carrying capacity. For purposes of the HMR CWE analysis a TOC is defined as *"the point at which the watershed would undergo irreversible degradation supported by a positive environmental feedback loop"*(IERS 2010).

Two types of TOCs for the Project area watersheds are defined:

1. Project Area TOCs determine the threshold of impact significance to sediment yield for development and redevelopment actions taken within the Project area (i.e. those portions of Madden, Homewood and Quail Lake Creek and Intervening Zone 7000 watersheds within the Project area boundary). The Project Area TOCs help gauge 1) whether existing conditions within the Project area already exceed the Project Area TOCs, and 2) whether estimates the level of impact from the Project would exceed Project Area TOCs within the Project area boundary. Exceedance of a Project Area TOC constitutes a significant impact requiring mitigation under TRPA codified regulation.

2. Total Watershed TOCs determine the threshold of impact significance to sediment yield for future development and redevelopment actions that could be taken outside the Project area considered cumulatively with those actions taken, as defined by the Project, within the HMR Project area (i.e. the portions of the Madden, Homewood and Quail Lake Creek

and Intervening Zone 7000 watersheds located upstream and downstream of the Project area ADDED to those portions of Madden, Homewood and Quail Lake Creek and Intervening Zone 7000 watersheds within the Project area boundary). The Total Watershed TOCs gauge the incremental contribution of the Project to cumulatively considerable impacts when combined with future reasonable and foreseeable projects outside the Project area portions of the watersheds. Exceedance of a Total Watershed TOC could constitute a potentially cumulatively significant effect as defined by CEQA and TRPA.

The TOCs were developed using two main components. The first component is quantitative and provides modeled annualized sediment yields that could theoretically result from build-out of base allowable land coverage permissible under current TRPA Bailey land use coefficients. The second component is qualitative and consults several levels of stream condition assessments, surface water quality from a period of record dating back to 1989, and other watershed indicators (i.e., 2007 HMR Watershed Atlas, professional knowledge of the Project area hydrology, field evidence) to support or discount the quantitative TOC for the four watersheds of study. These qualitative elements are used as 'checks' or indicators to support of refute the quantitative, modeled TOC findings.

HMR CWE Analysis

The HMR CWE analysis employs a process and model that reflect those utilized in the development of the Lake Tahoe Total Maximum Daily Load (TMDL) and described in the *Lake Tahoe TMDL Technical Study* (Lahontan and NDEP 2007). The Lake Tahoe TMDL process employed the Loading Simulation Program in C++ model (LSPC), a nationally recognized watershed model developed by the United States Environmental Protection Agency (USEPA) (http://www.epa.gov/ATHENS/wwqtsc/html/lspc.html). At its core, the LSPC model considers watershed hydrologic processes as they depend on climate, topography, and land-use to determine the runoff and sedimentation rates from each defined land-use category within a watershed. The sedimentation rates are summed to estimate the watershed sediment yields reported in metric Tonnes per year (T/yr).

The HMR CWE analysis utilizes the LSPC model land use inputs, topography and climate conditions and sediment rates from urban areas, as defined for the Lake Tahoe TMDL, together with model computed runoff rates and Project area field-measured, pervious area erosion rates to determine sediment yields from each land use. These baseline land use categories are described by existing conditions (i.e., No Project or Alternative 2). By varying land uses within each of the four watersheds to reflect changes proposed by the Project, it is possible to estimate the relative impacts to annual sediment yields that could occur from the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6.

The following steps that resulted in a GIS dataset of some 20,000 polygons were taken to setup the HMR CWE analysis for the existing conditions and simulate each of the project alternative land-use conditions to estimate sediment yield (T/yr).

1. The 1-meter land use raster dataset are converted into a feature (polygon) dataset using the standard ESRI "raster to poly" toolset.

2. The average slope for each land use is calculated based on 10-meter grid dataset. This dataset is simplified to a 100-meter grid and intersected with the baseline land-use dataset. The slope for each land use is determined as an area-weighted average.

3. The soil parent material (volcanic or granitic origin) is used to determine sediment rates per unit of runoff from pervious areas. This key parameter for each watershed is derived from the 2007 NRCS soil survey GIS data layer.

4. The unpaved (dirt) roaded area, used in the original TMDL modeling effort, under-estimated the actual dirt roaded areas found in the Homewood area. As such the dirt road land use category area is increased by approximately 958,311 square feet or 22 acres to reflect field-measured land use and land coverage conditions while adjoining vegetated land use category areas were reduced by an equivalent amount. This correction results in a more realistic representation of existing conditions.

5. For the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6, the land uses are adjusted (added or subtracted) for each watershed to reflect proposed changes in land use under each alternative. The total watershed areas are held constant.

6. Following the Lake Tahoe TMDL Pollutant Reduction Opportunities Report, reductions in sediment yield are established based on the pollutant load reduction measures proposed under each project alternative.

7. The resulting sediment yields from each set of land use conditions are summarized and graphically displayed.

Section 3 of this report further details the HMR CWE analysis methodology.

Existing Compliance with Project Area and Total Watershed TOCs

The modeled existing sediment yields from the Madden Creek, Quail Lake Creek and Homewood Creek watersheds and Intervening Zone 7000 are used as the baseline to describe existing conditions. Table ES-1 presents the existing Project area sediment yield for each watershed as compared against the Project Area TOC for that watershed and the Total Watershed sediment yield, which combines the Project area sediment yield with the sediment yield for the portions of the watershed located upstream and downstream of the Project area, for comparison against the Total Watershed TOC for that watershed.

Table ES-1. Annualized Sediment Yield Estimates –Existing Conditions vs. Project Area and Total Watershed TOCs

	Baseline Sediment Yield for Project Area (T/yr)	TOC for Project Area (T/yr)	Baseline Sediment Yield for Total Watershed (T/yr)	TOC for Total Watershed (T/yr)*
Intervening Zone 7000	62	55	361	355
Madden Creek	459	435	1036	1085
Homewood Creek	828	865	906	955
Quail Lake Creek	152	147	409	462
Totals	**1501**	**1502**	**2712**	**2857**

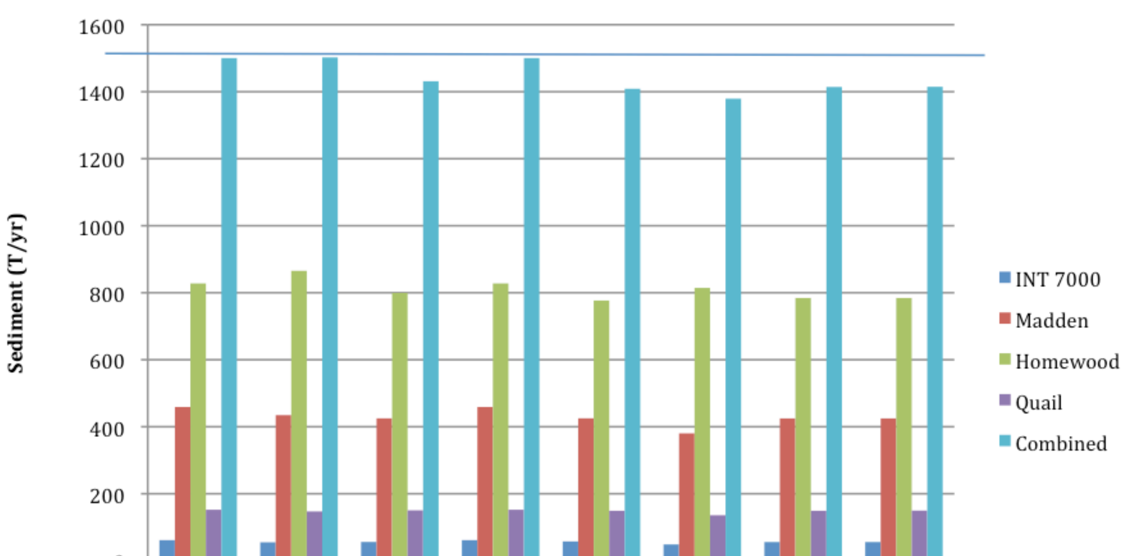
Source: IERS 2010

Notes: * TOC for Total Watershed equates the Project Area TOC plus the Outside of Project Area TOC. The Outside of Project Area TOCs are as follows in T/yr: Intervening Zone 7000 – 300; Madden Creek – 650; Homewood Creek – 90; Quail Lake Creek – 315

The modeled results demonstrate that the Homewood Creek watershed has a sediment yield that is below its Project Area TOC and Total Watershed TOC. Quail Lake Creek and Madden Creek watersheds are estimated to have sediment yields that exceed their Project Area TOC, while the sediment yields for the whole watersheds are below the Total Watershed TOC. Intervening Zone 7000 is estimated to have a sediment yield that exceeds its Project Area TOC and the Total Watershed TOC.

Future Compliance with Project Area and Total Watershed TOCs

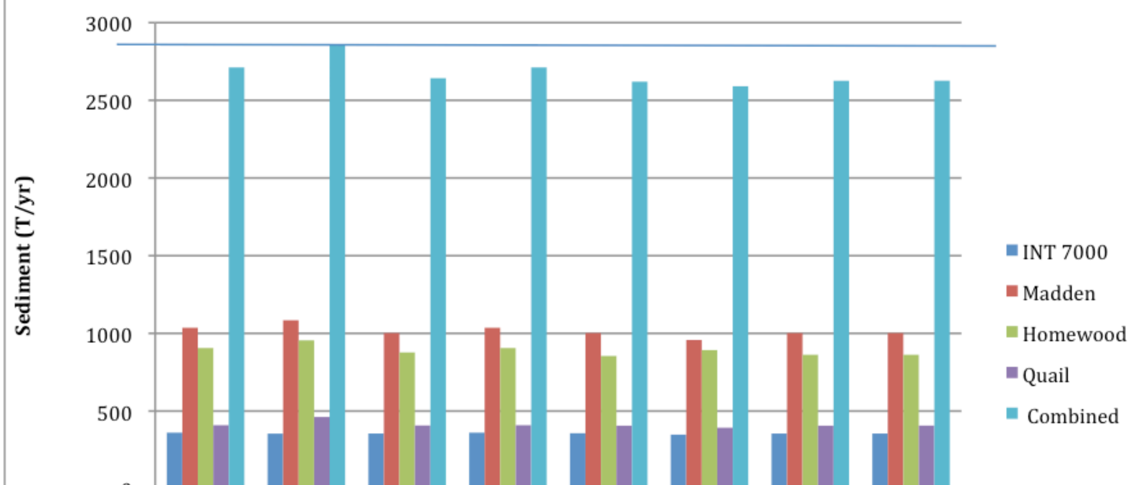
Figure ES-1, following, presents modeled Project area sediment yields for Homewood Creek, Madden Creek, Quail Lake Creek watersheds and Intervening Zone 7000. The HMR CWE analysis concludes that implementation of the Proposed Project (Alternative 1) or Alternative 3, 5 and 6 will reduce Project area sediment yields as compared to baseline conditions. Sediment yields will be reduced to a level which is at or below the Project Area TOC in Homewood Creek, Madden Creek and Intervening Zone 7000 (note: Intervening Zone 7000 is reduced to within 1 T/yr of the Project Area TOC, which is within the LSPC model margin of error – Mark Grismer, 2010). Quail Lake Creek sediment yield is reduced but remains above the Project Area TOC.



	Baseline	TOC	Project	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
INT 7000	62	55	56	62	58	49	56	56
Madden	459	435	425	459	425	380	425	425
Homewood	828	865	799	828	777	814	784	784
Quail	152	147	151	152	149	136	149	150
Combined	1500	1502	1431	1500	1409	1379	1414	1415

Figure ES-1. Sediment Yields (T/yr) for Project Area Watersheds vs. Project Area TOCs

As displayed in Figure ES-2, following, the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6 will reduce Total Watershed sediment yields from the four study watersheds as compared to existing conditions. As compared to the Total Watershed TOCs, sediment yields modeled for proposed conditions under the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6 will not exceed Total Watershed TOCs for Madden Creek, Homewood Creek or Quail Lake Creek watersheds and Intervening Zone 7000, noting that the modeled sediment yield in Intervening Zone 7000 is close to the TOC and within the expected range of error for the HMR CWE analysis. The development and redevelopment actions defined by the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6 is expected to reduce combined sediment yields to Lake Tahoe by approximately 69 T/yr for cumulatively beneficial effects to surface water quality and beneficial uses.



	Baseline	TOC	Project	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
INT 7000	361	355	356	361	357	348	355	355
Madden	1036	1085	1002	1036	1002	957	1002	1002
Homewood	906	955	877	906	855	892	862	862
Quail	409	462	407	409	406	393	406	406
Combined	2712	2857	2642	2712	2620	2590	2625	2626

Figure ES-2. Sediment Yields (T/yr) for Total Watershed vs. Total Watershed TOCs

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Section 1: Introduction to the Homewood CWE

This Cumulative Watershed Effects (CWE) analysis has been conducted to assist in the planning and understanding of the cumulative impacts of redevelopment at the Homewood Mountain Resort (HMR), especially as those impacts relate to area sediment yield and water quality. Planning for the resort redevelopment is being conducted within the Ski Area Master Plan Guidelines of the Tahoe Regional Planning Agency (TRPA). Appendix 5 of the Guidelines outlines the requirements for preparation of a CWE analysis. These requirements are fully addressed in the following sections of this report.

There are two unique elements of the HMR CWE analysis that have not been realized in other CWE assessments. First, this CWE analysis is linked directly to the Lake Tahoe Total Maximum Daily Load (TMDL) study summarized in the 2007 TMDL Report (Roberts and Reuter, 2007). Analyses derived from Phase 2 of the Tahoe TMDL process was used to develop the sub-basin sediment yield analyses in this report. Second, each sub-basin annual sediment yield as presented here is derived from a combination of sub-basin land-uses and annualized climate information as used in the TMDL modeling efforts with field-measured sediment yields[1] from plots within the Homewood area and across the Tahoe Basin. These elements have helped create a more complete, defensible and repeatable numerical output than has previously been achieved in the Tahoe Basin as well in most other CWE studies. The Tahoe TMDL Report, based on a nationally recognized model and peer reviewed by watershed scientists and regulatory staff, provided the unique opportunity to develop a CWE that represents a study with widespread applicability to the Tahoe TMDL and, when linked to the ongoing intensive monitoring in the Homewood watersheds, to erosion-related projects throughout the Tahoe Truckee region and beyond.

The primary application of the HMR CWE analysis is to evaluate the <u>relative</u> impacts of the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6, to existing conditions (the No Project or Alternative 2) in terms of sediment yield and other ecological variables, and then compare those to a Threshold of Concern (TOC), which is a sort of ecological tipping point[2]. In the HMR CWE analysis, the threshold of concern was developed using two main components, per directive from TRPA (see Appendix D). The first component is quantitative and provides a modeled derived annualized sediment yield. The second is qualitative and includes two stream condition assessments and water quality data. A more complete discussion of the TOC is provided in Section 2 of this report.

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[1] Over 1000 field plots of sediment yield and infiltration data were used to develop sediment delivery curves that were then used in the TMDL model to produce sediment yield values over a range of site conditions.

[2] TOCs are discussed in detail in Section 2 of this document.

[3] The term 'positive feedback loop' can be misleading. The term is adapted from system cybernetics such that a

[2] TOCs are discussed in detail in Section 2 of this document.

1.1 Cumulative Watershed Effects Analysis Use and History in Tahoe

The use of CWE analysis for ski areas in the Lake Tahoe Basin was pioneered at Heavenly Mountain Resort in the early 1990's (Holland 1991) to model the impacts of new activities within a ski area master planning process, to identify mitigation needs and to identify monitoring activities needed to assess development impacts. The CWE methodology was derived from a USDA Forest Service method for modeling the potential or expected impacts of logging and associated activities on sediment movement and water quality. A CWE analysis has been conducted twice at Heavenly Mountain Resort, once in 1993 and again in 2005. The introduction to the 2005 Heavenly CWE provides a good description of the utility of the CWE analysis as part of a master planning process.

> *A Cumulative Watershed Effects analysis is a **qualitative** evaluation of the overall health of a watershed and the sensitivity of the watershed to disturbances. It includes a qualitative evaluation of a watershed that is supported by quantitative measurable parameters. The purpose of the CWE Analysis completed in 1993 (Holland) for the Heavenly watersheds was to identify erosive areas, estimate the relative impacts on erosion caused by facilities or activities related to past development and proposed projects, and determine appropriate mitigation.*
>
> *~2005 Heavenly Cumulative Watershed Effects Model Revision*

For both of the Heavenly CWE analyses, erosion was estimated using the Modified Universal Soil Loss Equation (MUSLE), which is an empirical equation for estimating annualized sediment yields due to sheet and rill erosion from mildly sloping lands. It incorporates the four major factors affecting erosion as individual parameters including climate (precipitation), soil characteristics, topography, and ground cover. This information was then translated into a conceptual quantity called 'Equivalent Roaded Acres' or ERA. While commonly used, it should be noted the ERA concept has not been independently tested (Reid pg 283 in Elliot, 2010). From this information, and based on observations and assumptions about watershed processes, a conceptual threshold is defined assuming that a level of disturbance exists within the watershed that will cause the stream channel network to 'unravel' or to reach an ecological tipping point such that a positive hydrologic and sediment transport feedback loop[3] develops whereby irreversible damage (e.g. excessive channel scour/incision leading to collapsing hillslopes) occurs. This conceptual tipping point is known as the Threshold of Concern or TOC. In the past decade, this concept as applied in the CWE analysis has been a subject of considerable debate and study albeit with very limited actual field data (Elliot, MacDonald, others, also see Chapter 5 USEPA, 2005). These assessments discuss the validity of and problems with CWE assessments, including deficiencies in the MUSLE-ERA approach. A great deal of progress has been made since the Heavenly CWE analyses were undertaken and

[3] The term 'positive feedback loop' can be misleading. The term is adapted from system cybernetics such that a positive feedback loop is one that feeds itself or is self perpetuating.

CWE methodology has progressed far beyond what is currently considered the standard by TRPA. CWE limitations, non-validated assumptions and potential inaccuracies present challenges that can result in non-representative output. The HMR CWE analysis was developed by working collaboratively with TRPA and Lahontan agency staff. A more robust approach, linked directly to the Tahoe TMDL, was developed and agreed upon by staff and HMR. As a result, in this CWE analysis, we have taken a more rigorous modeling and field analysis approach that represents a significant improvement in CWE analyses and addresses shortcomings of other CWE assessments.

1.2 CWE-Lake Tahoe TMDL Linkage

In the *National Management Measures to Control Nonpoint Source Pollution from Forestry* (USEPA 2005, pg 4-5), the authors note that "Because TMDL assessments calculate all point source and non-point source pollution for a watershed, ***a TMDL is essentially a cumulative effects analysis*** *(emphasis added)*", further supporting and legitimizing the watershed modeling based approach developed here for the Homewood CWE. Given that the Lake Tahoe TMDL analyzes the HMR watersheds and Intervening Zone 7000[4], that approach, according to the USEPA, offers a greater level of accuracy than previous CWE attempts in the Tahoe Basin (USEPA 2005 "Problems in Cumulative Effects Analysis" pgs 4-5 to 4-6). For a more complete discussion of the limitations and potentials of CWE analyses, see MacDonald (2000).

In summary, the HMR CWE analysis is designed to quantify the existing conditions annualized sediment yields from the Homewood area, assess other available watershed condition information and compare those variables to a Threshold of Concern (TOC). This analysis is completed not only for the HMR property for the entirety of all three watersheds (Quail, Homewood and Madden) that the HMR development touches. The specific approach used here represents a significant, or quantum advancement in CWE analyses as it includes watershed-scale analysis of the hydrologic processes controlling sediment loading across multiple watersheds within which the proposed project area is only a very small fraction. It also addresses some of the known limitations of CWE analyses while forming the foundation of future adaptive management in the HMR property. The CWE report itself is used to help determine if: 1) the current development both within the HMR project area and within the 3 watersheds exceeds the TOC; 1) whether the proposed development and development alternatives exceed the TOC; 2) what effects the proposed development and development alternatives may have on sediment yields, and 3) if the development *combined with all foreseeable development* in the subject watersheds will exceed the TOC.

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[4] Intervening Zone 7000 or INT 7000, are terms used to describe areas between clearly delineated watersheds that are believed to drain water directly to Lake Tahoe. Intervening Zone 7000 includes areas between the Quail, Homewood and Madden Creek sub-basins from Tahoma to Homewood.

Section 2: Defining the Threshold of Concern

2.1 Overview

The Threshold of Concern (TOC) is a conceptual limit past which further hydrologic, soils or ecologic impacts in a watershed are assumed to have either irreversible or unacceptable consequences. As the original CWEs were typically sediment-transport focused, the idea of 'too much' disturbance has been translated into some 'tipping point' at which the watershed, specifically the stream and drainage channels, would begin to incise and streambanks, hence hillslopes collapse as a result of greater runoff rates with no further disturbance. In fact, the watershed sediment transport processes and the landscape as a whole would be modified resulting in possible loss of riparian habitat and enormous sediment deliveries downstream. It is assumed that this tipping point can be discerned in evidence from the sediment, water quality and/or streambank signatures. Soil compaction, road building and other disturbances that would deliver an increased amount of water flow and sediment to streams would tend to cause a self-perpetuating stream channel and watershed unraveling process. Whether or not, such a threshold exists or can be identified quantitatively, it is clear that at accumulation of watershed impacts, there is likely to be an increase in sediment yield, reduction of habitat, loss of soil water storage, and other watershed characteristics or properties, that are unacceptable to land managers and regulatory agencies.

2.2 TOC and CWE Relationship

The CWE is designed to address the anticipated limits (TOC) to which watersheds can be disturbed before an ecosystem function of importance (e.g. preservation of water quality) is altered to an undesirable level or irreversibly. Setting a TOC presumes that an upper limit of disturbance (i.e. coverage and therefore sediment yield) exists and that the watershed 'healing' process is on a time-scale that is unacceptable. The CWE analysis is directed at simply assessing the total current or anticipated impacts on soils and stream sediment loading from a particular area and is compared to the TOC to see if the existing or proposed development (and commensurate sediment yield) is above or below the TOC. As a result of this subtle difference, two bases were used in the HMR CWE, one to assess watershed sediment yields for each project alternative as they depend on proposed land-use changes and the other for setting the TOC based in part on what land-uses currently exist and what changes could be anticipated under current permitting allowances. The two are related in the following manner: Overall sediment yields (as determined by the LSPC-based CWE modeling) were determined by calculating the amount and types of coverage in the project area (that land owned by HMR within the 4 watershed areas) for each of the proposed alternatives and adding that to total existing and potential future coverage outside the project area but within the four watersheds. Those coverages were converted to appropriate land use categories in the LSPC model, which is what the LSPC model uses as a basis for calculations, and sediment yields were calculated (see 'Methods' section). Additionally, the potential future coverages for the overall CWE analysis were calculated using both the Bailey Land Capability System and the Individual Parcel Evaluation System (IPES) where appropriate and converted into appropriate land use categories in the model. Also factored in to the analysis was the result of a recent land capability challenge (LCC) within the project area.

The overall TOC used a combination of quantitative and qualitative parameters, as previously discussed. For the quantitative sediment component of the TOC, total future (maximum allowable) coverage was calculated for both inside and outside the project area[5] based solely on the Bailey Land Capability System as directed by TRPA staff (see Appendix D and Chapter 20 of TRPA Code of Ordinances and Bailey 1974)[6]. This threshold was directed by TRPA staff as it is the current land capability system in use for non-single family home development, and was agreed upon by all team members.

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[5] Note that the Heavenly Valley CWE only analyzed land within the jurisdiction of Heavenly Valley Ski Corporation. TRPA staff requested that the HMR CWE analyze the entirety of the watersheds, even though some of the areas are not under the jurisdiction of Homewood Mountain Resort, thus making extrapolation into the future somewhat problematic.

[6] Soils in the Lake Tahoe Region have most recently been mapped by the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) and are described in the Soil Survey of the Tahoe Basin Area, California and Nevada (USDA 2007). It is important to note that for land capability, coverage and permitting purposes TRPA currently uses the Bailey Land Capability system, which is based upon the Soil Survey of the Tahoe Basin Area, California and Nevada (Rogers 1974). The 2007 soil survey is being proposed for adoption and integration into the Bailey Land Capability System as part of the TRPA Regional Plan Update, but cannot be used until/if it is formally adopted.

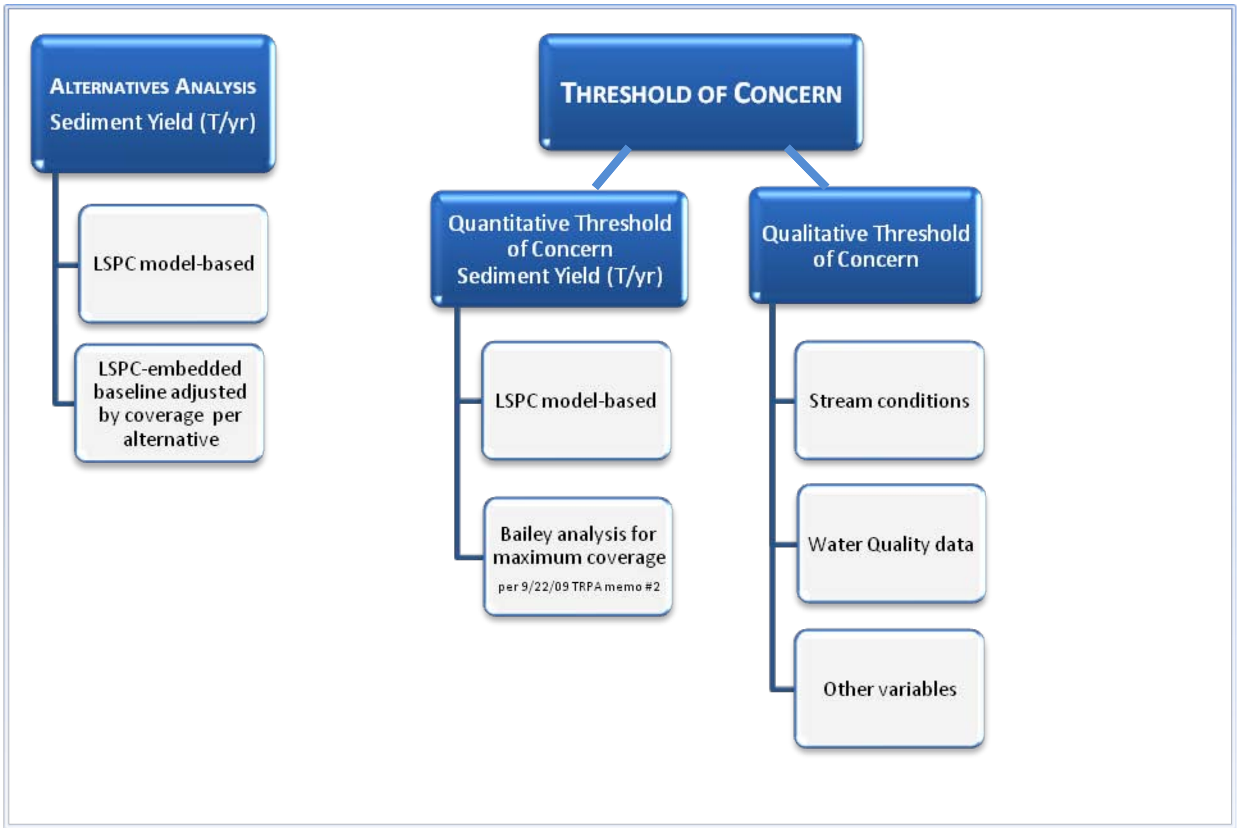


Figure 1: Graphical representation of sediment yield and TOC elements. This graphic shows each area of sediment yield analysis (Alternatives and TOC) and the elements of the TOC itself.

The following parameters were used to determine the TOCs for Madden Creek, Homewood Creek, Quail Lake Creek and INT7000, per direction from TRPA staff (Scott Frazier, Heather Gustafson (Beckman) and David Landry and approved by Joanne Marchetta per memo directives included in the Appendix D):

1) The current Bailey Land Capability overlay maps adjusted for a more accurate slope (slope phase adjustment-for land coverage and sediment yield (T/yr)) inside the project area
2) The 1974 Bailey Classification and Bailey allowable coverages for areas outside the project area
3) Stream conditions assessments;
4) Stream Water quality data
5) Other watershed indicators (such as potential build-out under a revised Bailey).

These elements are then considered together in order to make a semi-subjective, 'best professional judgment' decision as to whether a) the watershed drainage system sediment transport capability and structural (stream bank and channel) stability is currently beyond a TOC and b) whether it may, upon completion of redevelopment activities, exceed a TOC. The two main elements plus the additional variables are considered separately and if any suggest clear exceedance of watershed stability, greater scrutiny is called for and in some cases, mitigation is considered. Since the ultimate TOC is, in effect, an interpretation of these elements, we must consider the variables carefully and consider whether there are clear and defensible indicators that when taken together, suggest that current or anticipated future land-use conditions will result in exceeding this TOC.

2.3 Threshold of Concern Determination

The TOC consists of the watershed-scale sediment yield (quantitative) element, and qualitative soils, stream channel and stream water quality elements. The quantitative element is determined from watershed process modeling using LSPC developed annualized infiltration and runoff rates as applied to land-use categories [7]determined from existing, proposed and TRPA permittable base allowable coverage (e.g. Bailey allowable coverage). As in the TMDL process, sediment rate factors for each land-use category were determined either from field plot measurements for pervious areas, or as modified by anticipated BMP installations and their relative effectiveness in releasing suspended sediment and nutrients downstream. The qualitative element of the HMR TOC is based on field observations of upland soils and stream channel conditions and a historical analysis of stream water quality data. The water quality data is evaluated to determine if clear trends of increasing sediment loading are occurring per unit of streamflow. These two elements are combined through the presumption that if the 'qualitative' indicators suggest that a sediment transport capability threshold has **not** been exceeded under present or existing conditions reflective of the past several years, then the sediment yields determined from the watershed modeling efforts based on climate and land-use conditions of those same years faithfully represents our best scientific judgment of below TOC conditions. Moreover, this modeling effort enables 'disaggregation' of the land-use components of the overall sediment yield from each watershed for existing conditions such that they can be re-assembled to project what annualized sediment yields may be expected for TOC land-use conditions and later, proposed project alternative conditions. As a result of this linkage in TOC analyses, we first discuss the qualitative element followed by the quantitative assessment of the Homewood area TOC.

2.4 The Quantitative TOC Element – Watershed Sediment Yields

While the qualitative field assessments and semi-quantitative water quality evaluations provide direct evidence that the Homewood area watersheds are not currently at a hydrologic threshold, by their nature they provide little in the way of quantitative targets by which to set an upper limit of concern. One possible quantitative target would be that set by meeting Basin-wide TMDL related reductions in fine sediment and presumably total sediment loading of 32%, but development of such a number

[7] Land use categories are specific categories within the LSPC model that are assigned specific sediment yield values.

also requires an assessment of the current loading values. Presently, recent or current sediment or fine sediment loadings, or yields can only be determined through watershed modeling efforts such as that employed in the initial TMDL-related studies using LSPC. We adopt this latter approach to determine annualized sediment yields (T/yr) for TRPA allowable coverage[8], existing coverage (per TMDL modeling) and project alternatives coverage of the area watersheds. The TOC sediment yield is developed from the allowable land coverage classifications of the 1974 Bailey Land Capability System, translated into land use categories in the LSPC model. This system assigns coverage coefficients based on soil type, vegetation and land slope[9]. This 'allowable coverage' component of the TOC is considered a legally defensible threshold as the Bailey system limiting development is the permitting standard applicable to the Homewood area development. Moreover, similar to the CWE type analysis, the Bailey system is predicated on the concept that impermeable coverage resulting from development beyond the soil/slope capability would result in irreparable damage to hydrologic function within the watershed and subsequent excessive discharge of sediment to Lake Tahoe from each watershed (Bailey, 1974, pgs 1,2). Site specific slope adjustments (as directed by TRPA staff) were made to the Bailey overlay map for the areas in question as there is more refined topographic information in the area than was available for the 1974 Bailey mapping effort. The topographic information was derived from current USGS topographical maps (prepared by Tri State Survey, LLC). This map is referred to as the 'slope phase adjusted map'. Based on this revised mapping, base allowable coverage was determined for each watershed. Allowable coverage within each watershed was then converted into specific land-use categories for use in the LSPC model to determine sediment yields for the area watersheds. Modeling analyses were completed for areas both inside and outside the HMR project area within each watershed to facilitate assessment of project-level impacts (i.e. inside of the project area) separately from potential whole watershed impacts.

In order to determine maximum allowable coverage both in and outside of the HMR project areas, TRPA Directives (September 22, 2009 and November 24, 2009, Appendix D), as well as the TRPA Ski Area Master Plan Guidelines, were followed. Within the Project area, the slope adjusted Bailey overlay was utilized. This exercise produced a total base (or maximum) allowable coverage. That coverage, in square feet, was converted into land-use categories and sediment yields determined using the LSPC hydrology information as described above by Dr. Mark Grismer. The result is total sediment as well as silt and clay yields in mass/year. For total sediment and silt, results are in Tonnes per yr (T/yr). For clay, output is reported in kg/yr.

[8] Based on Bailey and IPES allowable coverage

[9] Coverage limitations in the Lake Tahoe basin have been historically based upon the Bailey Land Capability System (Bailey, R. 1974) developed in part from the initial SCS soil survey of the Basin (Rogers, 1974). Since 1987, the IPES (Individual Parcel Evaluation System) system had been adopted for single family dwelling development on parcels that were vacant on or after that time.

Table 1 summarizes the annualized sediment yields determined for each watershed under Bailey allowable coverage. There are two caveats to using these values as direct (vs. comparative) sediment yield indicators. While the numerical modeling enables determination of theoretical sediment yields from areas inside and outside of the proposed project areas in each watershed, it is not clear that making such an artificial distinction is meaningful from a watershed hydrologic perspective as some of the project areas are not inter-connected, nor are some upland source areas that likely control streamflows and sediment transport. As such, sediment yields generated per watershed should be compared between watersheds as a whole. Secondly, it should be noted that INT7000 is **not** a single watershed with a definable discharge or drainage channel network. Rather INT7000 is an accumulation of individual hillslope areas between Tahoma and Homewood that ultimately drain to roadside channels along Highway 89. For such small hillslope areas, it is not likely that a hydrogeomorphic threshold could actually be defined, though it is possible that an individual hillslope could be impacted. Moreover, the spatial scale of this analysis for INT7000 does not realistically consider individual hillslopes that lack definable fluvial drainage systems. Finally, the project areas within INT7000 are fairly small relative to the definable watersheds so INT7000 sediment yields are not included in the overall summation of yields. Given these qualifiers, it should be kept in mind that this analysis is for comparative purposes and as all models, is an approximation of real systems.

The Bailey allowable coverage conditions represent the best estimate of the legally defensible quantitative TOC sediment yield for each watershed. It should also be noted that the Bailey allowable coverage TOCs are much lower than that which would be set using the new soil survey-based thresholds.

Table 1. Existing condition and Bailey land-use derived annualized sediment yields from which a numeric TOC can be determined.

Land-use conditions modeled	INT 7000			MADDEN			HOMEWOOD			QUAIL			TOTAL		
	in-proj	out-proj	Total	in-proj	out-proj	Total	in-proj	out-proj	Total	in-proj	out-proj	Total	All In	All Out	All
Existing Condition	*62*	*300*	*361*	*459*	*577*	*1036*	*828*	*78*	*906*	*152*	*257*	*409*	*1500*	*1211*	*2712*
TOC	*55*	*300*	*355*	*435*	*650*	*1085*	*865*	*90*	*955*	*147*	*315*	*462*	*1502*	*1354*	*2857*

2.5 Qualitative TOC Elements – Field Observations of stream channel morphology, water quality and other soil indicators

This part of the TOC includes presentation and interpretation of stream channel conditions, historic water quality data and general field observations during soils restoration activities in the three watersheds. These somewhat more qualitative elements are presented to establish a field-based, non-model component to the TOC as described above. These elements are used to help determine whether physical evidence exists in the field indicating that ongoing watershed degradation is underway. This degradation would be an indication that the TOC may have been reached or exceeded. This field evidence for the TOC is especially valuable in cases where the modeled sediment yields suggest that the TOC may be reached or exceeded. Thus, this qualitative evidence is used to corroborate or refute the numeric or quantitative TOC as developed under the LSPC model.

2.5.1 Stream Channel Morphology Assessment

TRPA assessment

Every five years the TRPA has committed to assess the conditions of streams within the Lake Tahoe Basin for fish habitat. The rating system is described in the 2006 Threshold Evaluation by TRPA (TRPA, 2006). The streams in the project area watersheds are rated "Marginal" for resident fish; the lowest of the three rankings. As described below, such a ranking for the three streams in the project area watersheds stems in part from them being among the steepest gradient streams in the Lake Tahoe basin, making them inherently marginal at best for fish habitat . Therefore, comparison to other streams such as the Upper Truckee River, Trout, General, Blackwood, Ward or other lower gradient creeks is not a useful approach in determining the condition of the project area creeks. Further, two of the creeks, Madden and Quail, tend to be intermittent in all but the wettest years and therefore not readily habitable for fish. Homewood Creek runs year around in portions, primarily as a result of flows from two springs.

Entrix-Kleinfelder Assessment

In recent years, two stream channel condition assessments were conducted at HMR. Entrix, Inc. performed a stream channel condition assessment in 2005 on behalf of Placer County as part of the Homewood Erosion Control Project. Entrix evaluated stream conditions of the lower portions of the three major drainages on HMR property; Madden Creek (from River Mile [RM] 0.0 to 1.0), Ellis Creek (aka Homewood Creek) (from RM 0.0 to 0.7), and Quail Lake Creek (from RM 0.0 to 0.9). Entrix utilized the Stream Condition Inventory (SCI) protocol to assess the stability of the creeks. The findings of the assessment were presented in a 2006 report and in Kleinfelders' "Stream Channel and Baseline Surface Water Assessment-HMR, Homewood California" dated November 12th, 2007.

The second stream channel condition assessment was performed by Kleinfelder in October/ November 2006. Kleinfelder evaluated stream conditions and stream stability of the upper portions of Madden Creek (from RM 1.0 to Louise Lake at RM 2.08), Homewood Creek (RM 0.7 to 1.89), and Quail Lake Creek (RM 0.9 to 0.97) as well as and unnamed drainage (from RM 0.0 to 0.7) located between Madden and Homewood Creek. The results of this assessment are presented in Kleinfelders' "Stream Channel and Baseline Surface Water Assessment-HMR, Homewood California" dated November 12th, 2007.

A critical element in the interpretation of both the Entrix and Kleinfelder reports is the lack of discussion of temporal changes in stream conditions relative to large or even catastrophic flow events and the process of equilibration. That is, both Rosgen and Montgomery-Buffington discuss the concept of the dynamic nature of streams and the impact-equilibration response that is almost constantly underway in stream systems. That process is more pronounced and in constant play in high gradient streams where even moderate pulse events can add to the already high energy system is such as way that impacts to stream channels and banks result in responses that would be considered abnormal in lower energy (gradient) systems. The runoff events of 1997 and 2005 were not discussed in the Klienfelder report when summarizing and interpreting this data and Entrix's data. However, given the extreme nature of those two runoff years and the dynamic nature of channel processes, the point in time assessments of Kleinfelder and Entrix can be used to suggest that the streams within the project area are resilient and are responding naturally to the high flow years of 1997-98 and 2005-06. It should be noted that the Rosgen system was developed in much lower gradient streams and the Montgomery-Buffington system, while discussing elements such as bedrock limited stream reaches, is generally applied to lower gradient mountain streams. Nonetheless, the ratings indicate a relatively stable system when graded so soon after a 100-year event (1997-98). We base that interpretation on the fact that many of the stream channels are in fair to good condition which is unlikely to be the case if the watersheds had reached a critical threshold (TOC).

Kleinfelder Stream Condition Assessment Methods and Conclusions

Kleinfelder classified channel segment (0.1 miles) conditions as good, fair, or poor. Streams were assessed in 0.1 mile segments and each individual segment was given a specific rating depending on a number of parameters. A portion of a stream was listed as "Good" when banks exhibited erosion only on outcurves, at obstructions, and otherwise infrequently. A segment was listed as "Fair" when channels were eroded intermittently in location not explained by stable fluvial processes. Poor conditions included extensive and continuous erosion on one or both banks.

- Approximately 75% of the Madden Creek section assessed by Kleinfelder (RM 1.0 to RM 2.08) was rated as good. Approximately 20% was rated as fair with 5% rated as poor.
- Approximately 92% of the Ellis (Homewood) Creek section assessed by Kleinfelder (RM 0.7 to RM 1.89) was rated as good. Approximately 7% was rated as fair.
- 100% of the Quail Creek section assessed by Kleinfelder (RM 0.9 to RM 0.97) was rated as good.
- Approximately 72% of the Unnamed Creek that was assessed by Kleinfelder (RM 0.0 to RM 0.7) was rated as good. Approximately 28% was rated as fair.

Overall, from the Kleinfelder assessment, less than 1.5% of the 3.67 miles of stream channels surveyed were in 'poor' condition, less than 15% were in the intermediate changing condition of 'fair', while the remaining channel reaches were in 'good' conditions within the three watersheds. From their analysis, following the wet water years of 1998 and 2005, the Homewood area streams have already adapted to land-use conditions at the time and show little to no evidence of increased sediment transport capability.

Entrix Stream Condition Assessment Methods and Conclusions

Entrix utilized the Stream Channel Inventory (SCI) protocol (Frazier, et al., 2005) to assess the stability of stream banks in channel segments located immediately downstream of the segments considered by Kleinfelder. The SCI method rates stream banks as stable, vulnerable, or unstable for each 0.1 mile stream segment. The SCI protocol is based on a checklist that considers the amount of vegetative cover, presence of boulders and other coarse bank material, bank angle, and other indicators of bank stability. Stable banks have no instability factors and greater than 75% cover (cover includes vegetation, large rock, downed wood, or erosion resistant soil types with clay and conglomerates). Unstable banks have less than 75% cover and at least one instability indicator. Vulnerable banks have greater than 75% cover with at least one instability indicator. According to Entrix,

- Approximately 60% of the Madden Creek section (RM 0.0 to 1.0) was rated as unstable with vulnerable and stable conditions each comprising 20%.
- Approximately 48% of the Ellis Creek (RM 0.0 to 0.7) section was rated as unstable while vulnerable and stable conditions comprised 23% and 29% of the channel, respectively.
- Approximately 60% of the Quail Creek section (RM 0.0 to 0.9) was rated as stable, while the remainder was considered vulnerable. 100% of the Quail Lake Creek section within HMR property was rated as stable.

Overall Stream Condition Classifications of Drainages within Project Area

The results of the Kleinfelder and Entrix stream condition assessments are illustrated in Figure 6, Channel Condition and Bank Stability. The results from the Kleinfelder and Entrix stream condition assessments were combined to provide an approximate summary of the stream condition classifications of each creek. The percentages for each stream condition classification were calculated by dividing each classification segment by the total length of the assessed stream segments using Figure 6. The results are summarized below.

Madden Creek

- Good/ Stable: 42%
- Fair/ Vulnerable: 21%
- Unstable/ Poor: 37%

Ellis (Homewood) Creek

- Good/ Stable: 70%
- Fair/ Vulnerable: 18%
- Unstable/ Poor: 12%

Quail Lake Creek

- Good/ Stable: 88%
- Fair/ Vulnerable: 12%
- Unstable/ Poor: 0%

Unnamed Creek

- Good/ Stable: 71%
- Fair/ Vulnerable: 29%
- Unstable/ Poor: 0 %

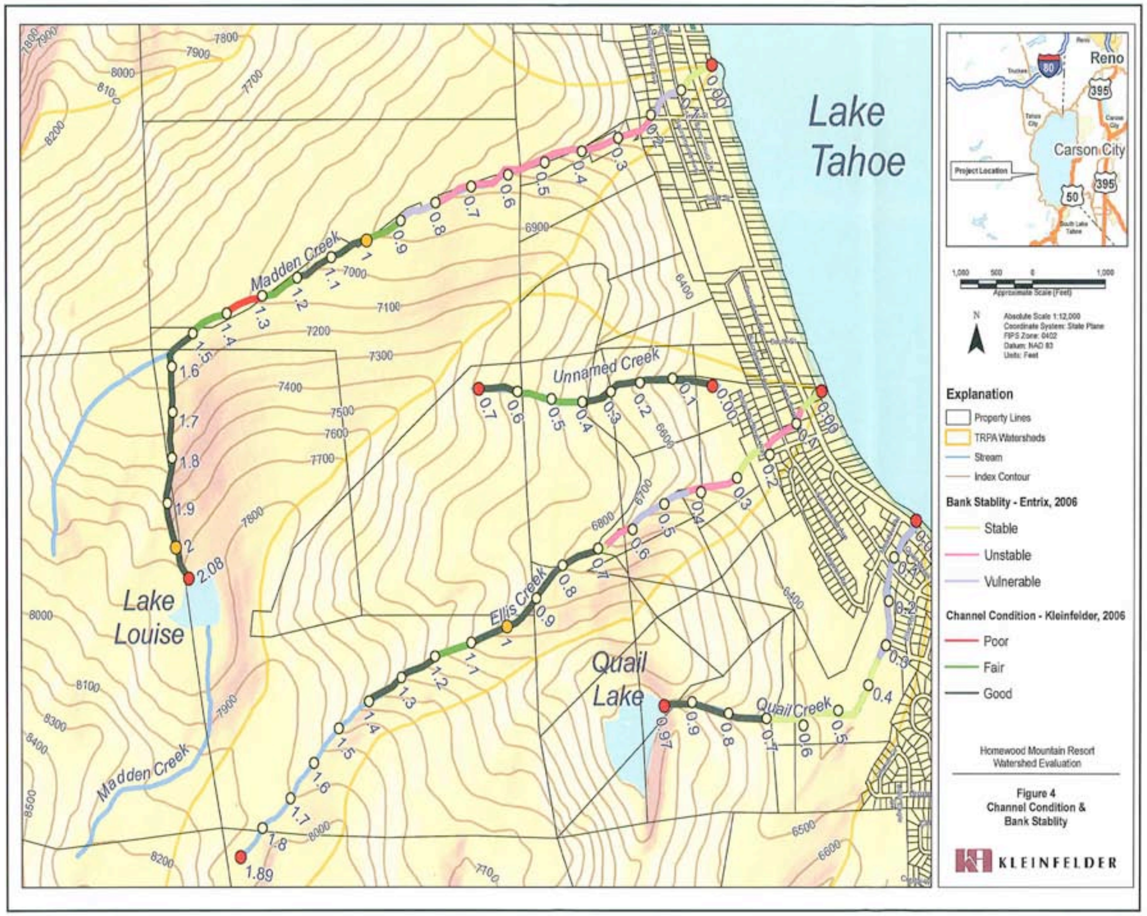


Figure 2: Channel Condition and Slope Stability

Conclusions Regarding Stream Condition Assessments Conducted by Entrix and Kleinfelder

The stream condition rating systems by used Entrix and Kleinfelder utilized pre-existing assessment methodologies that were developed for use on lower gradient streams and are therefore not expected to adequately characterize stream conditions for the type of high gradient small watershed streams encountered in the Homewood area. In fact, the three streams assessed are among the shortest and steepest in the Lake Tahoe basin and consist of a great deal of glacial 'debris', which is extremely erodible. Generally used rating assessment methodologies have not been developed for the small, high gradient, steep walled (in places) creeks such as are encountered in the project area[10]. (That is, there is no 'standard' or industry norm.) For example, the Stream Condition Inventory Technical Guide (Frazier, et al., 2005) was developed for the entire United States Forest Service-Pacific Southwest Region. This guide explicitly states limitations on using the SCI method on high- gradient streams such as those in the Homewood area. In an effort to avoid this limitation, the Kleinfelder stream condition assessment did not utilize an established assessment methodology, referring instead to more generalized geomorphological evaluations. In order to determine the general adequacy of these methodologies for determining stream conditions, two individuals with local geomorphological experience and training were contacted and asked to provide additional general comments on the assessment and outcome of those assessments:

- **Mark Grismer PhD, PE,** Professor of Hydrology, Soils and Environmental Engineering, Depts. of LAWR and Biological & Agricultural Engineering, UC Davis, (2/25/2010): According to Dr. Grismer, the lower stream sections are generally more dynamic and meandering in this type of watershed than typically encountered in lower gradient watersheds, depending on the local gradient and sediment yield from upstream. Upper reaches tend to incise more and are hard rock controlled. Homewood and Quail Creeks should be considered reasonably stable – there should always be conditions that would meet the "vulnerable/unstable" classification reported in the Entrix report since very steep and short, recently glaciated watersheds are more actively equilibrating (cutting and stabilizing).
- **Matt Kiesse** River Run Associates, fisheries biologist and stream/watershed geomorphologist, 20 years practice in Tahoe Basin (3/05/2010): The stream condition inventory protocol that was utilized by Entrix does not take into account natural erosion conditions or natural fluvial process of the stream channels. Pre-existing geological conditions of the channel area will influence natural erosion conditions of the channel and those defining conditions, critical in a recently glaciated and very steep watershed, are not well represented in the Entrix assessment. Human modifications may also play a significant role in determining stream conditions and

[10] An assessment document reference was found but we were unable to locate it in the TRPA or TIMMS website or the USGS archives (Huffman and Associates, 1998).

the Entrix approach does not include anthropogenic influences. Further inquiry into the natural conditions and processes of the stream channel would need to be made before making definitive statements regarding stream conditions/stability.

CWE assessments must be approached with a level of caution in interpreting information. Site-specific conditions should be taken into account. As suggested in the Sierra Nevada Ecosystem Project report CWE section suggests: "*Users are expected to exercise* ***judgment*** *in modifying ERA coefficients and TOCs for particular sites*. "(SNEP, Volume III, pg. 13 Berg et al, 1996; also, see MacDonald, L. 2000).

Overall, despite their limitations, the overall field assessment of the stream channel conditions in the Homewood area not surprisingly reflects dynamic nature of stream channel evolution. In addition, it is important to note that very little of the proposed re-development will occur near streams and most will take place in the lower area of the mountain thus having very little influence on *upstream* reach source areas that control channel flow velocities and subsequent channel stability. The North Base portion of the development does not drain directly to a stream. Most of the South Base portion of the development is in the Homewood (Ellis) Creek drainage and in fact, is located directly adjacent to the creek. However, stream restoration is slated in this lower reach as part of the project and implemented BMPs are expected to improve channel conditions over what currently exist (i.e. large paved areas, old buildings with few BMPs.) The only part of the development in the upper watershed is the mid-mountain Lodge in an area that drains towards Madden Creek. Soil restoration and slated BMPs for themed-mountain lodge are expected to improve overall infiltration capacity, thereby reducing net runoff from the area as compared to current conditions. The present and planned soils restoration activities (e.g. dirt road removal) across the Homewood area are expected to have the largest impacts on the local streams in terms of reduced rates of runoff and sediment loading from overland flow processes as a result of greater infiltration and soil-water storage generated by the restoration. Such reductions in upstream generated flowrates will increase the likelihood of channel restoration success at the lower gradient channel sections downstream near which more of the re-development is to take place.

Of the nearly 4 miles of stream channels considered, the majority are in good/stable condition suggesting that an "unraveling" type threshold has not been reached, as the following sections indicate.

2.5.2 Stream Water Quality Data

Stream water quality data is actually a quantitative element within the qualitative section of this report in that the data requires some subjective or expert interpretation. This data is used as a reference to see whether clear trends exist in water quality. Variations in the stream water quality over time, provide an indirect measure of the sediment/nutrient transport capacity of the watershed as well as a direct measure of the stream channel stability. In both cases, relative invariance of the sediment/nutrient mass discharged per unit volume or depth of watershed runoff relationship across wet and dry water years provides an insight into whether or not threshold conditions have been reached or exceeded. Often only stream water quality (concentration) information is available rather than loading information as needed for say the TMDLs (and therefore this CWE analysis), however, lately more combined stream flow rate and water quality information is becoming available. For the HMR project area, there is existing stream water quality data as a product of Lahontan Waste Discharge Requirements (WDRs) requirements.

WDRs are imposed in an effort to bring facilities into compliance with the Clean Water Act (CWA). Sampling, as required by HMR's WDRs, are done at specific areas at weekly intervals during runoff periods; that is, in the spring until water flow volume decreases to baseflow levels absent significant overland flow. These weekly samples are averaged to a monthly basis and then that monthly mean is used to create a yearly average or Mean of Monthly Means (MOMM). As actual stream water quality data reflects an integration of watershed and channel processes underway at the time the water sampling is completed, it is analogous and complimentary to the stream channel morphology assessments described above. This approach is something of a regulatory standard and as such implies a defensibility through compliance with TRPA and State of California discharge limits. See Box 1 for additional discussion.

Figures 3, 4 and 5 summarize the MOMMs for total suspended sediment (TSS), nitrogen (TN) and phosphorous (TP) in the streams of the Homewood area, respectively, for the period 1995-2008. The sampling points and frequency were designed to develop an understanding with time of the influence of the ski resort on water quality[11]. Water quality objectives are also indicated by the solid red lines in each figure. As is evident in these figures, no clear temporal trend is apparent for any of the water quality parameters and with the exception of TP concentrations and wet year conditions of 2005, the MOMM values are well below water quality objectives. From the perspective of establishing proximity to or exceedance of a watershed threshold condition, trends of increasing concentrations from one similar water year to the next (e.g. between dry years of 2001-04 to 2006-07) would suggest evolving degradation within the watershed. Seemingly large MOMM concentrations of TSS in 2005 are associated with the very high flows and if expressed on a per unit of runoff would likely have been similar to other years (2005 was an extremely wet year, associated with a number of landslide activities throughout the Tahoe Truckee area). Reasons for occasional high nutrient concentrations such as that for TN in 2001 are less clear, though this likely a result of very low flow conditions resulting in less dilution of nitrogen leaching from the forest soils during near continuous base flow conditions in this dry year.. What is especially interesting is the total phosphorus which is often higher in the Madden 1 sampling location at the top of the watershed.

[1111] A note about water quality monitoring: HMR has undertaken near continuous water quality monitoring for sediment and flow, which presents a rare opportunity to analyze watershed signatures from runoff events. This monitoring is being used to develop TMDL restoration actions and expected responses. While not directly related to the redevelopment efforts, this monitoring will fill some of the gaps in the MOMM analysis.

In fact, in every instance, P is higher in the uppermost elevation sampling station. This may be a result of the sampling location being just below Lake Louise where TP is concentrating during the summer months and/or a high level of native P in the watershed itself, such as is observed in the Martis Valley watersheds.

2.5.3 Stream Water Quality Conclusions

In summary, increasing trends in stream water concentrations with time are not observed, but rather highs and lows of various constituents that appear to be linked to episodic runoff events and high water years. Thus, water quality data offers corroboration to the stream channel assessments that the watershed drainage system (streams) capability as of the 1995-2008 period are not above threshold conditions and that watershed modeling based on this period should also represent below TOC conditions. Taking the water quality objectives as another measure of watershed threshold conditions, with the exception of TP, Homewood area stream water quality is well-below such a threshold. And even in the case of TP, phosphorus levels generally trend downward as water passes through Homewood property, suggesting that generic objectives are actually below background levels in these watersheds. Homewood area stream MOMM concentrations would even meet the TMDL planning and implementation perspective of decreasing fine sediment loading by approximately one-third in the next 15 years, another possible measure of a TOC.

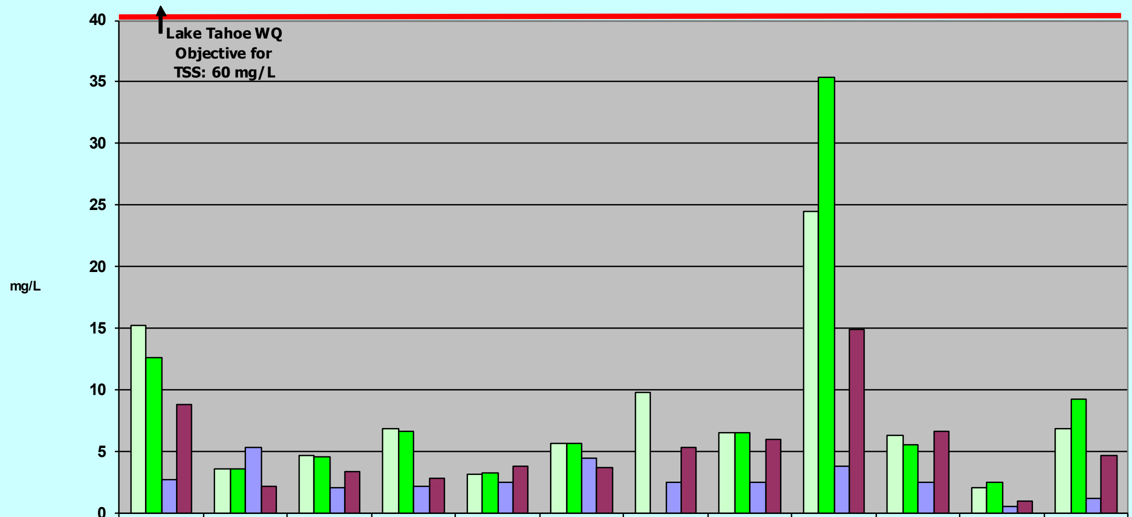
Box 1 Use of Current Water Quality Objective Data

The only actual data available at this time to evaluate a TOC is the past 13 years of water quality monitoring data for the two main watercourses in the HMR property, Homewood (aka Ellis) and Madden Creeks. The data, while meeting the requirements set forth in the Waste Discharge Requirements (WDRs), represents the accepted regulatory standard of water quality assessment in the Lahontan Region. Samples are taken weekly during the runoff season when sites are safely accessible and are then translated into an average for the entire water year. Although Water Quality Objectives (WQOs) for total phosphorus, total nitrogen, and suspended sediment have been established for surface waters in the Lake Tahoe Hydrologic Unit in the Water Quality Control Plan for the Lahontan region (Basin Plan), it is difficult to compare the WQOs to the available data because samples were collected primarily during high flows and do not represent the full range of the hydrologic cycle within the water year.

A correct comparison to these WQOs requires samples collected at fixed intervals (e.g. monthly, weekly or more often through the entire water year). Unfortunately, the surface waters at the project cannot be sampled on a fixed interval schedule due to snow conditions during the winter months. Additionally, it appears that surface waters in the project area are naturally high in total phosphorus as is indicated in the phosphorus graph. This graph shows that P is higher in the upper watershed in many years and is lower in the lower sampling point. Phosphorus levels during high flows tend to be above the WQOs at both upstream (background) and downstream sampling locations. Results for suspended solids are well below WQOs for both upstream and downstream sampling sites. An additional limitation on sampling is that Madden Creek seldom runs year round and thus cannot be sampled during the late summer and fall months in any case. It should be noted that if year round samples were taken, the average mean would most likely go down.

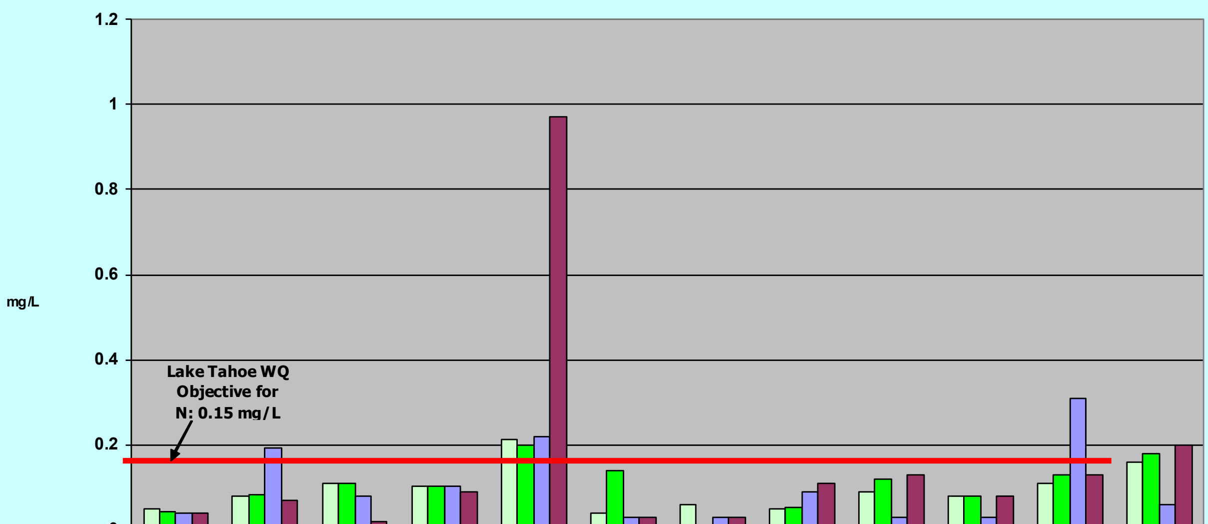
Based on the data limitations, water quality was evaluated by comparing differences between upstream and downstream constituent concentrations. Figures 3, 4 and 5 illustrate the (WDR) dataset for suspended solids, nitrogen, and phosphorus. This dataset does not indicate negatively trending degradation. In fact, the data does not indicate consistent pollutant values between the downstream and upstream monitoring locations.

The TRPA Ski Area Master Plan Guidelines state that the first objective in setting the threshold of concern is to evaluate if a Cumulative Watershed Effect has already occurred (page 36 of TRPA CWE Guidelines). An evaluation of available water quality monitoring data from 1995 to 2008 does not indicate that the project area watersheds are currently experiencing an irreversible, serious, and/or wholesale change in sediment loading rates (see Figures 3, 4, 5) but, like most relatively stable watersheds, respond to climate variations.



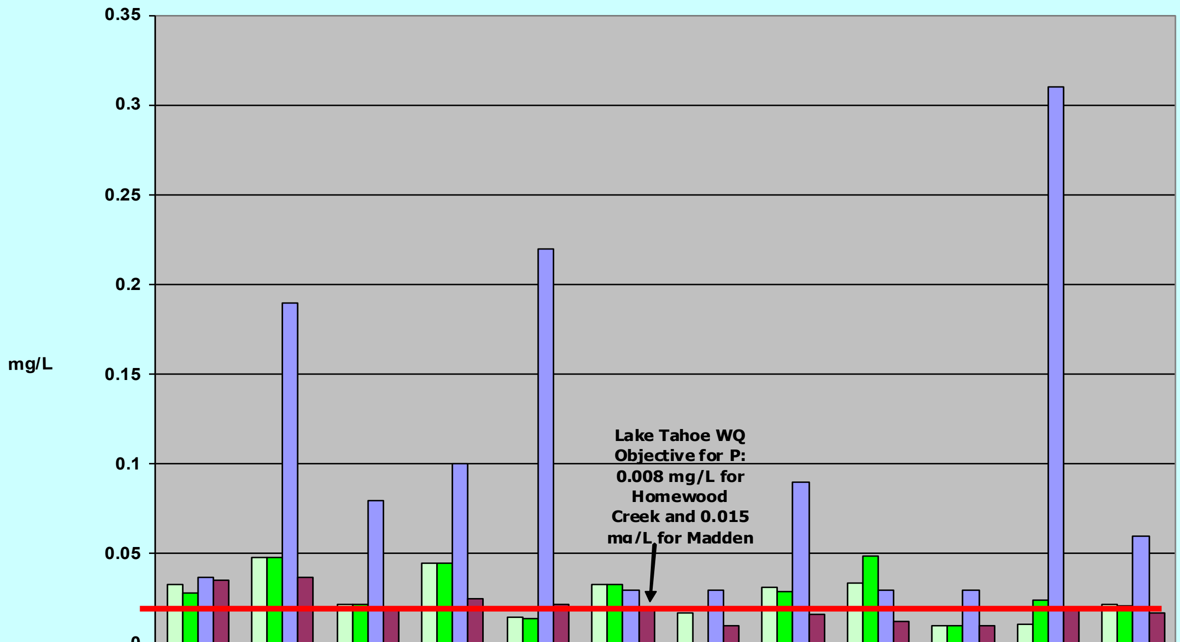
	1995	1996	1997	1998	2001	2002	2003	2004	2005	2006	2007	2008
Homewood-1	15.2	3.6	4.7	6.8	3.2	5.7	9.8	6.5	24.5	6.3	2.1	6.8
Homewood-2	12.67	3.58	4.58	6.67	3.29	5.69		6.54	35.33	5.57	2.46	9.21
Madden -1	2.75	5.3	2.1	2.16	2.5	4.5	2.5	2.5	3.8	2.5	0.57	1.25
Madden -2	8.85	2.2	3.4	2.8	3.8	3.75	5.3	6	14.9	6.6	1	4.7

Figure 3: Total Suspended Solids Concentrations (Annual Mean by Water Year)



	1995	1996	1997	1998	2001	2002	2003	2004	2005	2006	2007	2008
Homewood-1	0.05	0.08	0.11	0.1	0.21	0.04	0.06	0.05	0.09	0.08	0.11	0.16
Homewood-2	0.043	0.082	0.11	0.1	0.2	0.14		0.053	0.12	0.08	0.13	0.18
Madden -1	0.037	0.19	0.08	0.1	0.22	0.03	0.03	0.09	0.03	0.03	0.31	0.06
Madden -2	0.037	0.07	0.02	0.09	0.97	0.03	0.03	0.11	0.13	0.08	0.13	0.2

Figure 4: Total Nitrogen Concentrations (Annual Mean by Water Year)



	1995	1996	1997	1998	2001	2002	2003	2004	2005	2006	2007	2008
Homewood-1	0.033	0.048	0.022	0.045	0.015	0.033	0.017	0.031	0.034	0.01	0.011	0.022
Homewood-2	0.028	0.048	0.022	0.045	0.014	0.033		0.029	0.049	0.01	0.024	0.021
Madden -1	0.037	0.19	0.08	0.1	0.22	0.03	0.03	0.09	0.03	0.03	0.31	0.06
Madden -2	0.035	0.037	0.02	0.025	0.022	0.02	0.01	0.016	0.012	0.01	0.019	0.017

Figure 5: Total Phosphorus Concentrations (Annual Mean by Year)

2.5.4 Other Watershed Indicators

Homewood Mountain Resort began environmental improvement work in 2007 with development of a watershed problems and opportunities analysis (separate from this CWE) that has been used to help determine where problem areas exist and where restoration and environmental improvement efforts would be most efficaciously applied. This analysis resulted in a Watershed Plan that included a GIS identification and assessment of most of the roads, streams, ski runs and forested areas of the Homewood project area. It has provided a robust on-the-ground understanding of the Homewood area watersheds. While this area has endured a number of impacts in the past, especially road building for mining, logging, and ski area operation, there is little evidence of widespread erosion, either through the presence of obvious and widespread rills, large gullies or mass slope failures. Certainly, the presence of roads, ski trails and some bare areas has increased runoff locally, however, only one location of obvious and insidious gullying was discovered and it was associated with a manmade drainage channel mid-mountain within the Homewood Creek watershed. This area is presently being addressed through intensive soil restoration efforts. Ongoing road runoff is observed but usually runs through forest floor cover, either by design or naturally, before it reaches the creeks. Additionally, there are a number of abandoned roads that are revegetating spontaneously, which indicates that recovery from past disturbances is underway.

Thus vegetative and soil indicators (vegetation cover, infiltration, soil movement and others) suggest that the watersheds as a whole, while experiencing some accelerated erosion, have not yet reached nor appear to be on a trajectory towards exceedance of an irreversible threshold. Rather, it appears that less severe disturbance areas are in a process of active recovery/equilibration and greatly disturbed areas are in the process of being restored or slated for future soils restoration work.

As with the stream channel assessments and stream water quality data, no field evidence was discovered suggesting that the Homewood area watersheds are in a state of "unraveling" that might be associated with exceeding a sediment transport capability threshold beyond which the stream channels and landscape is unlikely to recover.

Qualitative TOC Conclusions

The qualitative TOC elements, taken together, do not call out blatant areas of concern or clear suggestions that we have either reached a TOC or are on a trajectory to do so. These qualitative elements are physical, real time field 'reality checks' to be used in conjunction with the quantitative TOC in helping to determine allowable impacts in the watersheds.

2.6 Other Watershed Impacts: Oil and Grease Discussion and Results

While not technically part of the TOC discussion, oil and grease are adjunct pollutants that can foul water quality. Thus, we present the following discussion in order to offer evidence that oil and grease will not be a contributing element of water quality, and thus watershed degradation.

Oil and grease represent a reasonable potential to harm beneficial uses. There are two main pathways for oil and grease to enter surface waters. The first is from highway legal vehicles, such as cars and trucks. The second is from accidental spills from snow grooming and equipment maintenance. The likelihood of oil and grease entering surface waters will be compared to the existing conditions.

2.6.1 Existing Conditions

Currently, the north and south base areas are dominated by parking lots for private vehicles. Oil separators are installed in both areas to remove oil and grease from stormwater. The resort maintenance facility is located in the southern end of the south base area. A spill of oil or grease here could quickly enter surface water from the storm drains. It is possible that a large spill could overwhelm the oil separators.

2.6.2 Proposed Project and Alternatives 3, 5 and 6

As part of the Proposed Project and Alternatives most of the parking (95%) in the north and south base areas will be underground. These underground parking areas eliminate most of the current potential for outflow of oil and grease and make the capture of oil and grease easier since rainfall cannot flush oil and grease into surface water drainages before containment. In addition, spills within underground parking areas can be contained quickly. For above-ground parking, high-quality sand oil separators will be installed to prevent oil and grease from entering surface waters.

Also as part of the Proposed Project and Alternatives 3, 5 and 6, snow grooming machine parking and equipment maintenance will occur at the mid-mountain station. The construction of the mid-mountain maintenance facility will include state of the art systems to capture oil and grease spills. The facility is located far from surface waters and much farther from Lake Tahoe, making the probability of any oil and grease reaching the surface waters and/or the Lake much lower.

2.6.3 Alternative 4

Alternative 4 divides the resort into 20 residential parcels. Oil and grease spill prevention and treatment are not required for residential parcels. The risk of oil and grease spills is assumed to be the same as other residential parcels around the region. However, very little actual data or understanding is available on the impacts of private homes on inputs of oil and grease to storm drain or sewer systems.

2.6.4 Conclusions

Oil and grease pollution has not been tracked in the Homewood watersheds. However, the development alternatives consider oil and grease pollution and make significant strides to minimize not only existing pollution pathways but also to lower probabilities of pollution by relocating potential sources of pollution. Therefore, oil and grease are not expected to pose threats to any of the watersheds during normal operations.

Section 3: CWE Analysis Methodology

3.1 Overview

The HMR CWE analysis models sediment yield (T/yr)[12] that could result from land use changes implemented under the Proposed Project (Alternative 1) and Alternatives 3, 4, 5 and 6 and compares those yields to existing sediment yields and TOCs. The HMR CWE analysis is built upon the watershed modeling conducted for the Lake Tahoe TMDL Pollutant Reduction Opportunities Report (Roberts, D. and J. Reuter, 2007). The Lake Tahoe TMDL process relied on the LSPC model, which is described in Box 2.

3.1.1 Tahoe TMDL Context

Since the 2005 Heavenly CWE analysis was completed, the Lahontan Regional Water Quality Control Board (Lahontan) has completed a Technical TMDL study (2007) for the Lake Tahoe Basin. The Lake Tahoe TMDL establishment process involved calibration of modeled tributary stream flows and sediment loads to existing data based on the years for which combined climate and streamflow data was available. The TMDL report also considered the "opportunities" or methods for possible sediment loading reductions from the forested uplands, stream channels and urban areas of the Lake Basin.

In an effort to make the HMR CWE analysis more accurate and relevant to the Tahoe TMDL and thus set a new standard for CWE analyses in the Lake Tahoe Basin, this CWE analysis employs the TMDL model input land-use data (for existing conditions) and annualized output hydrology (e.g. infiltration, runoff rates) information combined with the plot measured erosion rates per unit of runoff to determine sediment yields from the Homewood area.

The HMR CWE analysis is linked directly to the Lake Tahoe Total Maximum Daily Load (TMDL) study summarized in the Lake Tahoe TMDL Technical Report (Lahontan and NDEP 2007). Modeling data and analyses derived from Phase 2 of the Tahoe TMDL process was used to develop the sediment yield analyses in this report.

The original TMDL modeling effort provided a *hypothesis* of sediment yields for each sub-basin based on constant land-use conditions and annualized climate data (1993-2004) rather than a *prediction* of an annual sediment yield for any one particular year. Eventually, model predicted sediment yields per year for given sub-basin land-use conditions and actual climate information can be compared with measured accumulated daily sediment loads determined from actual stream water quality

[12] Wherever the term 'sediment yield' is used, unless otherwise stated, we are referring to annualized sediment yield in metric tonnes per year (T/yr) from a particular area. While a TMDL is based on a 'daily' load, the Tahoe TMDL and most others, group daily values into annualized values to make assessment and understanding more straightforward.

monitoring. We discuss existing and future monitoring efforts at HMR later in this report.

The LSPC model estimates existing pollutant yields and potentially achievable yield reductions by land use for each watershed in the Lake Tahoe Basin. The LSPC model assigns sedimentation rates for each land use category as defined by soil type and slope, with the exception of impervious land uses, which have no soil or slope dependence.

The following steps (that resulted in a GIS dataset of some 20,000 polygons) were completed to set up the HMR CWE analysis for the existing and proposed land use conditions:

1. The 1-meter land use raster dataset was converted into a feature (polygon) dataset using the standard ESRI "raster to poly" toolset.
2. The average slope for each land use was calculated based on 10-meter grid dataset. This dataset was simplified to a 100-meter grid and intersected with the land-use dataset for existing conditions. The slope for each land use was determined as an area-weighted average.
3. The soil parent material (volcanic or granitic origin) is used to determine sediment rates per unit of runoff from pervious areas. This key parameter for each watershed was derived from the 2007 NRCS soil survey GIS data layer.
4. The dirt roaded area used in the original TMDL modeling effort under-estimated the actual dirt roaded areas found in the Homewood area. As such the dirt road land-use category area was increased by approximately 89,030 m^2 (958,311 ft^2 or 22 acres) as measured in the field, while adjoining vegetated land-use category areas were reduced by an equivalent amount overall. This correction resulted in a more realistic representation of current conditions.
5. For the Proposed Project and each alternative, the land uses are readjusted (added or subtracted) for each watershed to reflect proposed changes in land use under each alternative. The total watershed areas were always held constant.
6. Following the Lake Tahoe TMDL Pollutant Reduction Opportunities Report, reductions in sediment yield were established based on the mitigation measures selected (see Pollutant Reduction Measures and Mitigation Measures below).
7. The resulting sediment yields from each set of land-use conditions are summarized and graphically displayed.

The annualized averaged climate (e.g. precipitation) and hydrology data from the period 1994-2004 as used in the TMDL modeling effort are used to develop the average infiltration, runoff and streamflow rates from LSPC. The modeled results are based on changing the land uses and sedimentation rates associated with those land uses, summing for both the project area portion of the watershed and for the total watershed area.

Box 2 The LSPC Model from the US-EPA

Watershed and Water Quality Modeling Technical Support Center of the USEPA defines the Loading Simulation Program in C++ with the following.

> LSPC is the Loading Simulation Program in C++, a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality on land as well as a simplified stream transport model. LSPC is derived from the Mining Data Analysis System (MDAS), which was developed by USEPA Region 3 and has been widely used for mining applications and TMDLs. A key data management feature of this system is that it uses a Microsoft Access database to manage model data and weather text files for driving the simulation. The system also contains a module to assist in TMDL calculation and source allocations. For each model run, it automatically generates comprehensive text-file output by subwatershed for all land-layers, reaches, and simulated modules, which can be expressed on hourly or daily intervals. Output from LSPC has been linked to other model applications such as EFDC, WASP, and CE-QUAL-W2. LSPC has no inherent limitations in terms of modeling size or model operations.

More information can be found at:
http://www.epa.gov/athens/wwqtsc/html/lspc.html

In summary, the HMR CWE analysis is designed to quantify the existing annualized sediment yields from the Homewood area and when combined with additional field stream channel observations and determination of sediment yields from allowable build-out conditions to determine the TOC against which project alternative impacts (sediment yields) can be compared. This approach represents a significant, or quantum advancement in CWE analyses as it includes watershed-scale analysis of the hydrologic processes controlling sediment loading across multiple watersheds within which the proposed project area is only a very small fraction. It also addresses some of the known limitations of CWE analyses while forming the foundation of future adaptive management on the HMR property. The CWE report itself is used to help determine if: 1) the Proposed Project or Alternatives 3, 4, 5 and 6 exceed the TOC; 2) what effects the Proposed Project or Alternatives 3, 4, 5 and 6 may have on sediment yields, and 3) if the Proposed Project or Alternatives 3, 4, 5 and 6 combined with all foreseeable development in the subject watersheds will exceed the TOC.

3.2 Assumptions

The LSPC, as with any model, makes various assumptions necessary to quantitatively describe complex natural processes. Therefore, where process measurements have not been made or the processes are not completely understood, the best available empirical science or judgment is applied in order to develop assumed relationships between process parameters as they are best understood. It is important to understand some of the assumptions embedded in the model in order to better understand the output. As with every model, these assumptions may or may not precisely align with the broad range of field conditions but were developed by the team of scientists and Lake Tahoe Basin agency staff to develop clarity and consistency in the model outcome.

3.2.1 LSPC Model Assumptions

The following assumptions are embedded in the LSPC model used in the HMR CWE analysis:

- Impervious surface runoff from buildings and paved surfaces is completely treated with one or more mitigation measures and does not produce significant pollutant yields.
- Impervious surface runoff is routed in such a way that no additional pollutants are entrained and such that no additional erosion is caused downslope.
- Paved roads are integrated with highly functional infrastructure components such that no additional erosion or sediment transport losses are created. This infrastructure includes roadside drains, piping, and treatment facilities.
- All water quality treatment facilities are perfectly maintained and thus are operating at maximum effectiveness.
- Ski trails always produce higher sediment yields than surrounding forested areas

3.2.2 Pollutant Reduction Measures and Mitigation Measures

The LSPC model estimates sediment yield for forested upland and urban land use areas. The Lake Tahoe TMDL Pollutant Reduction Opportunities Report defines a range of mitigation measures and quantifies the reduction in sediment yield for each mitigation measure and for each source area type (forested uplands and urban). Mitigation measures are called Pollutant Source Controls (PSC). For urban areas, those measures are lumped into two tiers of actions. Tier 1 PSCs reflect present day requirements for new construction projects while Tier 2 PSCs are additional measures above and beyond Tier 1 that may become part of efforts to reduce sediment loading efforts across the Basin in the future. Tier 2 PSCs include more advanced techniques and higher levels of maintenance. **Error! Reference source not found.**3 summarizes the total and fractional reductions assumed for Tier 1 and Tier 2 type mitigation measures.

Tier 1 measures are assumed for the urban areas for this analysis so that possible mitigation benefits are not overstated. While Tier 2 mitigation measures are presumed to be more effective due to the increased costs and associated efforts for fine sediment reduction from urban areas, this assumption has not been widely tested in the Lake Tahoe Basin. Thus, the more conservative Tier 1 measures are used in the model. Even though Tier 1 measures are assumed, it is important to highlight that the Proposed Project (Alternative 1) and Alternatives incorporate Low Impact Design (LID) elements as well as a number of other cutting-edge components that likely meet or exceed Tier 2 reduction targets. This assumption of Tier 1 measures produces a more conservative sediment yield value and likely understates actual achievable results.

Table 2: Pollutant Source Control (PSC) Examples (Roberts, D. and J. Reuter, 2007)

Land Use	Tier 1 PSC (Mitigation Measures)	Tier 2 PSC (Mitigation Measures)
Residential Multi-Family PSC-3	a. Private BMP implementation including soil stabilization, driveway paving, and so on as currently defined by TRPA.	a. Private BMP implementation including soil stabilization, driveway paving, and so on, as currently defined by TRPA. b. Control of over-the-counter fertilizer sales. c. Control of nonnative plant sales in the Basin and public education regarding Lake Tahoe-friendly landscaping. d. Increase in individual stewardship of all private land owners. e. High performance is assumed for the above measures—increased enforcement or incentives could be needed as an integral part of the PSC.
Urban Roads PSC-1	a. Road drainage system stabilization, sand trap installation, slope stabilization, and revegetation b. Minimal change in abrasive application rates c. Particulate recovery strategies focused on inter-storm removal in locations with greatest accumulation of particulates.	a. Road drainage system stabilization, sand trap installation, slope stabilization, and revegetation b. Advanced deicing strategies c. Rigorous and advanced particulate recovery strategies including sweeping, vacuuming, and sand trap vactoring d. High performance is assumed for the above measures

Table 3: Example of Pollutant Reductions for Tier1 and Tier 2 (Roberts, D. and J. Reuter, 2007)

Land Use	Pollutant of Concern	Existing Conditions (MT/yr)	Tier 1 PSC (Mitigation Measures)	Tier 2 PSC (Mitigation Measures)
Commercial	Total Nitrogen	2.472	2.136 (14% Reduction)	1.80 (27% Reduction)
	Total Phosphorus	0.702	0.536 (25% Reduction)	0.370 (38% Reduction)
	Total Suspended Soils	296.4	204 (31% Reduction)	112 62% Reduction)
	Fine Sediment	260.8	179.5 (31% Reduction)	98.6 (62% Reduction)
Secondary Urban Roads	Total Nitrogen	2.844	2.322 (14% Reduction)	1.80 (27% Reduction)
	Total Phosphorus	0.588	0.407 (31% Reduction)	0.378 (36% Reduction)
	Total Suspended Soils	150	100 (33% Reduction)	50 (66% Reduction)
	Fine Sediment	132	88 (33% Reduction)	44 (66% Reduction)

3.2.3 Road Removal and Restoration

The value of removing unpaved roads in the upper watershed is defined in the Lake Tahoe TMDL Pollutant Reduction Opportunity Report. Unpaved roads are classified by level of erodibility from Functional Condition Class A (low erodibility) to Condition Class F (high erodibility). Sediment rates increase from Functional Condition Class A to F as summarized in Table 4. Unpaved roads in the project area are generally characterized by highly compacted soil conditions, low to no surface cover, and high runoff and sediment yield rates. Some of the road areas are also associated with cut and fill slopes, which is taken into consideration in the model. For this analysis all unpaved roads are initially assumed to be at Functional Class F.

Road removal and restoration treatments include recontouring the road prism to match surrounding slopes where appropriate, soil loosening, incorporation of soil amendments, and application of fertilizer, seed, and mulch. This combination of treatments is designed to provide immediate protection against erosion and to achieve long-term sustainable sediment source control and establish an appropriate and self-sustaining native plant community over time via natural succession. For this analysis, a restored road segment is considered Functional Condition Class B, even though Class A is typically produced (as measured by simulated rainfall). Functional Condition Class B represents a conservative characterization of site conditions and associated sediment yield following careful implementation of this restoration treatment approach. (See Table 4, below, for a full description of soil functional classes).

Table 4: Descriptions for soil functional condition classes.

Functional Condition Class	Description
A	Fully functional forest soils – limited erodibility, high infiltration rates, and sustainable soil nutrient conditions.
B+	Approaching functional soil conditions as per class A; may not yet be sustainable, or are limited by available soils and slope.
B	Functional surface soil protection and initiation towards hydrologic functionality; long-term condition uncertain.
C	Disturbed sites with surface treatment (e.g. hydroseeding or erosion control fabric) that provide temporary cover but little functional erosion control.
D	No protective surface cover and limited infiltration capacity due in part to dispersed soil aggregates.
F	Compacted bare soil conditions; highly erodible.

3.3 Defining Existing Conditions

The LSPC model used an array of existing conditions data for analysis. For this exercise, some of that data was adjusted for greater accuracy where appropriate. Please refer to Appendix A for a full treatment of that data, which is abbreviated in the form of maps and tables. In order to reflect actual rather than verified conditions, the CWE analysis incorporated verified and mapped roads and associated land coverage and also includes dirt roads that existed on in the project area prior to current, on-going restoration efforts. The removal of 240,000 sq ft of roads is reflected in the model, (Note: As of November 2010, and estimated 350,000 sq ft of roads have been removed and restored). This approach reports sediment yields that are higher than what would be reflected by using verified roads only.

Existing land use within the project area includes developed area, roads, and ski trails. Table A7 summarizes the existing land use within the project area. Table 5 presents a breakdown of land uses within each project area watershed.

Table 5. Existing Land Use by Watershed

	Existing Land Use within the Project Area (m^2)				
Watershed	Developed Area	Roads	Ski Run/Vegetated	Water Body	**Total**
Intervening Area#7000	16,187 (174,235 ft^2)	24,281 (261,359 ft^2)	424,920 (4,573,801 ft^2)	-	469,435 (5,052,956 ft^2)
Madden Creek	-	52,609 (566,279 ft^2)	1,343,556 (14,461,916 ft^2)	24,281 (261,359 ft^2)	1,420,447 (15,289,564 ft^2)
Homewood Creek	4,047 (43,562 ft^2)	89,031 (958,322 ft^2)	2,031,522 (21,867,121 ft^2)	-	2,124,600 (22,869,004 ft^2)
Quail Lake Creek	-	16,187 (174,235 ft^2)	906,496 (9,757,442 ft^2)	56,656 (609,840 ft^2)	979,339 (10,541,517 ft^2)
Total	**20,234** (217,797 ft^2)	**186,155** (2,003,756 ft^2)	**4,706,494** (50,660,280 ft^2)	**80,937** (871,199 ft^2)	**4,993,821** (53,753,042 ft^2)

Source: 2004 TMDL GIS Dataset

3.4 Defining Proposed Conditions

*In order to define proposed conditions that would result for each alternative, land uses were changed within the model to accurately reflect those future conditions. For a complete technical discussion of those changes, please refer to "**Alterations to the Land Use Conditions for Analysis**", in Appendix A.*

Land use and land coverage changes assumed for the Proposed Project and Alternatives are defined in Appendix A. the following sub-sections 3.4.1 through 3.4.6 summarize the Proposed Project (Alternative 1) and Alternatives 2, 3, 4, 5 and 6. Table 6 provides a comparison matrix of the components proposed under each alternative.

Table 6: Summary of the Proposed Project and Alternatives (Nichols, 2010)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	Proposed Master Plan	**No Action (existing to remain)**	**No Code Amend. for Height**	**Privatize Resort**	**Urban Boundary Subdivision**	**Urban Boundary Lower Height Subdivision**
North Base						
Hotel						
Rooms	up to 75		up to 75	0	up to 75	50
Condo/Hotel Units	up to 40*		40*	0	0	25
Penthouse Condos	up to 30		up to 30	0	0	0
Residential Condos	up to 36		up to 36	0	up to 225	up to 145
Fractional Condos	up to 20		up to 20	0	0	0
Townhomes	up to 16		up to 16	0	0	0
Residential Lots	0		0	8	0	0
Workforce Housing	13		13	0	12	12
Commercial	up to 25,000sf		up to 25,000sf	1	up to 25,000sf	up to 25,000sf
Skier Services	Aprox. 30,000sf		up to 30,000sf	0	up to 30,000sf	up to 20,000sf
Parking spaces						
Day skier structure	270		270	0	156	156
Surface parking	50		50	0	80	80
Underground	450		450	0	534	534
Total Parking	*770*		*770*	*0*	*770*	*770*
South Base						
Residential Condos	up to 99		up to 99	0	0	up to 50
Maintenance	0		0	0	0	0
Parking spaces	150		150	0	0	65
Residential Lots	0		0	8	up to 16	up to 14
Skier Services	up to 2,000sf		up to 2,000sf	0	up to 2,000sf	up to 2,000sf
Mid Mountain						
Day Lodge	up to 15,000sf		up to 15,000sf	0	up to 15,000sf	up to 15,000sf
Gondola terminal	up to 18,000sf		up to 18,000sf	0	up to 18,000sf	up to 18,000sf
Maintenance facility	up to 15,000sf		up to 15,000sf	0	up to 15,000sf	up to 15,000sf
Water storage tanks	2		2	0	2	2

Notes

* up to 40 condo/hotel units, 20 of which could have lock-offs

3.4.1 Alternative 1- Proposed Ski Area Master Plan Project

The Proposed Project includes a new lodge, gondola, employee housing, and parking structure in the North Base area. Just south of the North Base, 16 townhomes would be built along an extended Tahoe Ski Bowl Way. In the South Base area, three residential condominium buildings would also be built. Also in the South Base area, part of the Homewood Creek SEZ would be restored. Additionally, other upland areas would be restored as well. A new mid-mountain lodge would be added at the upper gondola terminal and a new maintenance facility would be added on the upper mountain. Unused dirt access roads within the upper watersheds would be removed and restored.

3.4.2 Alternative 2 - No Project (Baseline/Existing Conditions)

There would be no changes to the existing land uses or activities within the project area. Sediment yields developed for this alternative employ the roaded area corrected land-use areas as developed from the 2004 GIS layers for the original TMDL studies.

3.4.3 Alternative 3 - No Code Amendment for Height

Alternative 3 assumes that there is no code amendment to allow taller buildings. This alternative contains the same number of residential, hotel, and commercial units as the Proposed Project; however, these units would be in more buildings and require a larger footprint. This would include four additional buildings within the North Base and three additional buildings within the South Base. Unused dirt access roads within the upper watersheds would be removed and restored. The Mid-Mountain Lodge will be the same as the Proposed Project proposal.

3.4.4 Alternative 4 - Privatize Resort

Alternative 4 is completely different from the Proposed Project. It assumes the project area is closed and is divided into parcels that allow 16 new private residences. The North Base parcel would remain a commercial land use. The dirt access roads to these residences would be paved. No other road restoration is assumed.

3.4.5 Alternative 5 - Urban Boundary Subdivision

Under Alternative 5, all of the proposed condominiums are located in buildings adjacent to Highway 89 at the North Base and in the existing gravel parking lot area. The parking structure and employee housing are moved from the gravel parking lot area proposed in Alternative 1 to a site adjacent to the skier services building. A new mid-mountain lodge will be the same as described for the Proposed Project . The South Base would be subdivided into 16 residential lots, which would each have a single-family residence. Unused dirt access roads within the upper watersheds would be removed and restored.

3.4.6 Alternative 6- Urban Boundary Subdivision-Lower Height

Under Alternative 6, the PAS 159 – Homewood/Commercial boundary line adjustment (PAS boundary amendment) proposed for the Proposed Project (Alternative 1) would be reduced to eliminate the proposed Townhouses at the North Base area. In addition, a majority of the South Base area would remain in PAS 157 with the exception of the site of the existing skier services lodge located north of Homewood Creek, which would be redeveloped into a multi-family residential condominium building and added to PAS 158 – McKinney Tract Residential. Under Alternative 6, the total number of TAUs proposed for the North Base area under Alternative 1 would be reduced from 155 to 75. Each of the TAUs would be located in the hotel/lodge building located north of the skier services building.

To offset the large reduction in TAUs under Alternative 6, the number of proposed multi-family residential units (for sale units) would be increased from 181 to 195. Under Alternative 6, 145 of the multi-family residential units would be located at the North Base area, spread out amongst each of the proposed residential buildings and also the upper floors of the skier services building. At the South Base area, up to 50 multi-family residential units would be located in one building located north of Homewood Creek, in the same location and design as one of the buildings proposed under Alternative 1. The remainder of the South Base area would include 14 single-family residential lots developed using existing HMR lots along with a small skier services building to service residents and skiers utilizing the Quail lift.

Alternative 6 includes 12 onsite affordable housing units that would be attached to the parking structure, (Building P) because the alternative parking structure location does not include enough land area for the 13 units included in Alternative 1 and 3. As such, Alternative 6 may require identification of additional offsite affordable housing for HMR employees. Under Alternative 6, the proposed development at the Mid-Mountain area will be the same as that for Alternatives 1, 3 and 5

3.5 Defining Actions Outside of Project Area

In order to ascertain land used changes on sediment yield for total watersheds, it is assumed that land use changes will occur both inside and outside of the project area in each of the four watersheds. Four actions are assumed to occur outside of the project area and these actions are incorporated into the future existing conditions (Alternative 2), the Proposed Project (Alternative 1) and the Alternatives:

1. New homes will be built on vacant land within the watersheds. The modeled values for changes in land use assumed that all vacant parcels above the IPES value of 726 would be built and each home would be built to the maximum allowable land coverage. Thus, where a home is built on a vacant lot, the model converts land from a vegetated land use to the single family impervious land use (SFI). These values are summarized in Table 7.
2. 100% of the residential homes will have BMPs installed, which represents a 97.5% increase in BMP implementation. Following the Lake Tahoe TMDL Pollutant Load Reduction Opportunities Report (Roberts, D. and J. Reuter, 2007), the modeled output was changed so that the four residential land uses (SFI, SFP, MFI, and MFP) produced less sediment yield based on the assumption that properly installed and maintained residential BMPs result in an overall reduction in sediment delivery. The result is the amount of land

converted from one vegetated land use to the single family imperious land use (SFI).

3. 100% of the commercial land area will have BMPs installed. Commercial land use is found only in INT7000 and Homewood Creek watersheds. The total INT7000 contains 95,196 m^2 (1,024,681 ft^2) and Homewood Creek watershed has 1,169 m^2 (77,155 ft^2) of commercial land. Based on the directives and assumptions employed in the Lake Tahoe TMDL Pollutant Load Reduction Opportunities Report (Roberts, D. and J. Reuter, 2007), modeled output showed that these areas produced less sediment following BMP installation.
4. The EIP projects within the four watersheds will consist of treating three roadway types: highway, secondary roads and dirt roads. CALTRANS and Placer County have committed to treating all of these road types within these watersheds. Following the directives and assumptions in the Lake Tahoe TMDL Pollutant Load Reduction Opportunities Report (Roberts, D. and J. Reuter, 2007), the total area received treatment and resulted in a reduced sediment yield within the model, as summarized in Table 6.

These changes were assumed and incorporated into the model at the direction of TRPA staff in order to define a clear and defensible future condition based on TRPA code.

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Table 7: Summary of Changes in Land Use from Future Residential Units Outside of Project Area

	Change in Land Use Change to SFI (m^2)			
Watershed	**Veg EP-2**	**Veg EP-3**	**Veg EP-4**	**Total**
Intervening Area #7	4,381 (47,157 ft^2)	24,094 (259,346 ft^2)	26,284 (282,919 ft^2)	54,759 (589,421 ft^2)
Madden Creek	38 (409 ft^2)	209 (2,250 ft^2)	227 (2,443 ft^2)	474 (5,102 ft^2)
Homewood Creek	72 (775 ft^2)	395 (4,252 ft^2)	431 (4,639 ft^2)	897 (9,655 ft^2)
Quail Lake Creek	34 (366 ft^2)	188 (2,024 ft^2)	205 (2,207 ft^2)	428 (4,607 ft^2)
Total	**4,525** (48,707 ft^2)	**24,886** (267,871 ft^2)	**27,148** (292,219 ft^2)	**56,558** (608,785 ft^2)

Table 8: Area of Roadway Outside of Project Area Treated by EIP Project

Watershed	Area of Roadway Within EIP Project by Watershed and Land Use (m^2)			
	Highway (CALTRANS)	**Secondary Road (Placer Co.)**	**Dirt Road (Placer Co.)**	**Total**
Intervening Area #7	88,793 (955,760 ft^2)	407,056 (4,381,514 ft^2)	16,878 (181,673 ft^2)	512,727 (5,518,947 ft^2)
Madden Creek	2,585 (27,825 ft^2)	2,585 (27,825 ft^2)	2,053 (22,098 ft^2)	7,223 (77,748 ft^2)
Homewood Creek	1,476 (15,888 ft^2)	6,209 (66,833 ft^2)	2,480 (26,694 ft^2)	10,165 (109,415 ft^2)
Quail Lake Creek	1,476 (15,888 ft^2)	17,834 (191,964 ft^2)	11,178 (120,319 ft^2)	30,488 (328,170 ft^2)
Total	**94,330** (1,015,360 ft^2)	**433,684** (4,668,136 ft^2)	**32,589** (350,785 ft^2)	**560,603** (6,034,280 ft^2)

Section 4: CWE Results and Conclusions

4.1 Introduction

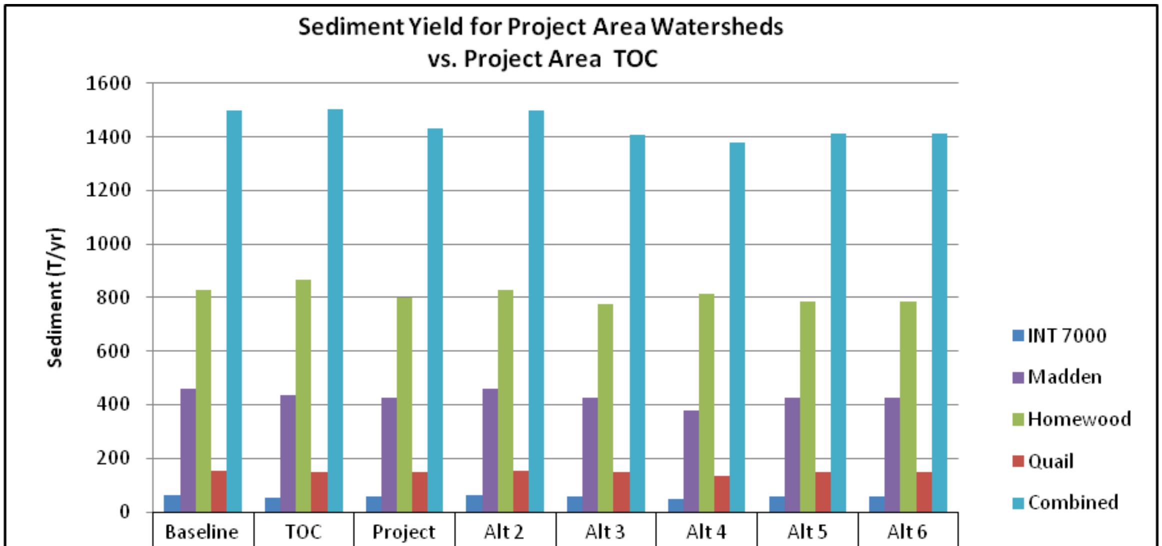
The following section presents the results for Project Area and Total Watershed sediment yields. Sediment yields in T/yr are compared against existing conditions represented under the No Project (Alternative 2) and Project Area TOCs and Total Watershed TOCs. Table 8 summarizes the sediment yields by watershed for each alternative as compared to those developed from Existing land-use conditions and to Project Area and Total Watershed TOCs.

Table 9: Sediment Yields by Watershed and Alternative

	INT 7000			MADDEN			HOMEWOOD			QUAIL			TOTAL		
	in	out	Tot Wtrshd	in	out	Tot Wtrshd	in	out	Tot Wtrshd	Ql in	Ql out	Tot Wtrshd	All In	All Out	All
Baseline	62	300	361	459	577	1036	828	78	906	152	257	409	1500	1211	2712
TOC	55	300	355	435	650	1085	865	90	955	147	315	462	1502	1354	2857
Project	56	300	356	425	577	1002	799	78	877	151	257	407	1431	1211	2642
Alt 2	62	300	361	459	577	1036	828	78	906	152	257	409	1500	1211	2712
Alt 3	58	300	357	425	577	1002	777	78	855	149	257	406	1409	1211	2620
Alt 4	49	300	348	380	577	957	814	78	892	136	257	393	1379	1211	2590
Alt 5	56	300	355	425	577	1002	784	78	862	149	257	406	1414	1211	2625
Alt 6	56	300	355	425	577	1002	784	78	862	150	257	406	1415	1211	2626
T/yr below TOC (project)			-1			82			78			55			214
% reduction from baseline			1.5%			3.3%			3.1%			0.4%			2.6%
t/yr reduction from baseline			5.3			33.9			28.3			1.7			69.2

4.2 Project Area Sediment Yields

Figure 6 illustrates the comparison of Proposed Project (Alternative 1) and Alternatives 3, 4, 5, and 6 project area sediment yields against existing sediment yield and Project Area TOCs. The potential impacts from project alternatives are discussed below according to watershed. Note that the proposed project and all of the alternatives result in a reduction of sediment in all the watersheds from 'baseline[13]' or existing conditions, largely due to the decrease in overall coverage as a result of project construction and the advanced stormwater treatments designed into the project. Note also that sediment reductions as a result of BMP implementation have been estimated conservatively, as described previously. It should also be noted that an inherent 'error' of +/- 5% in the model is expected and is, in fact, a low error rate for models of this type.



	Baseline	TOC	Project	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
INT 7000	62	55	56	62	58	49	56	56
Madden	459	435	425	459	425	380	425	425
Homewood	828	865	799	828	777	814	784	784
Quail	152	147	151	152	149	136	149	150
Combined	1500	1502	1431	1500	1409	1379	1414	1415

Figure 6. Project Area Sediment Yields vs. Project Area TOCs

4.2.1 Homewood Creek Watershed

The Homewood watershed is the only watershed area within the project boundary that is currently below the Quantitative TOC. The project reduces the expected annualized sediment yield from 828 T/yr to 799 T/yr, or 29 T/yr.

4.2.2 Madden Creek Watershed

The Madden Creek watershed is currently above the Quantitative TOC by 24 T/yr. This watershed contains a number of roads that will ultimately be removed to reduce

[13] "Baseline" is typically used in modeling exercises to describe existing conditions, since those conditions are a starting point. While some confusion can ensue when using the term baseline and existing conditions, for this analysis, baseline IS existing conditions.

sediment post project to 10 T/yr below the TOC and 34 T/yr below current conditions.

4.2.3 Quail Lake Creek Watershed

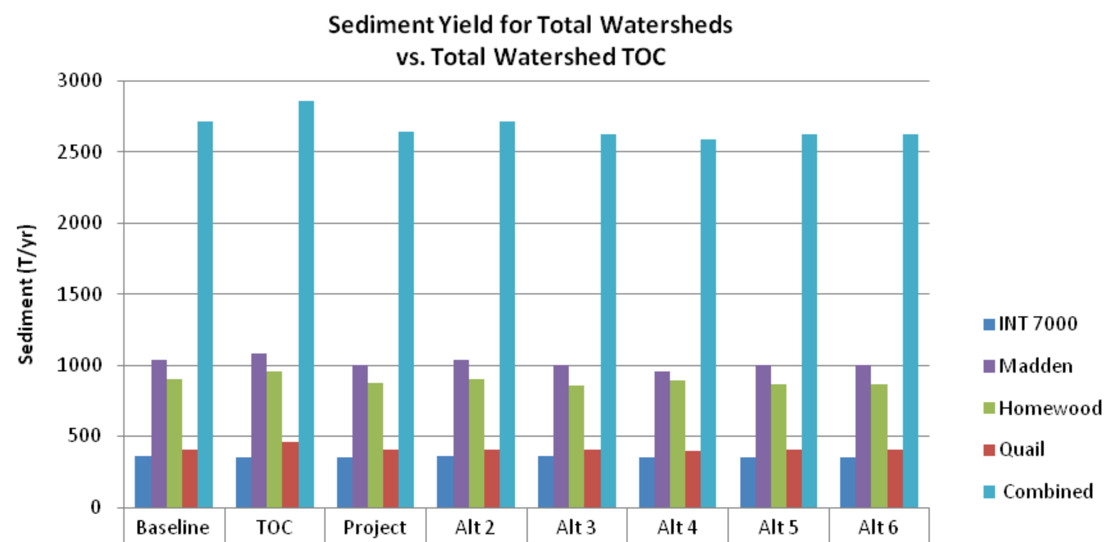
The Quail Lake watershed is currently 5 T/yr above the TOC, which is within the margin of error. Thus, this value may or may not be significant. Since the Quail Creek watershed will not be impacted by the development but will benefit from restoration efforts associated with the project, those efforts will result in a 1T/yr reduction in estimated sediment. Again, this value is well within the margin of error of the model. However, the model does show an improvement, albeit minor.

4.2.4 Intervening Zone 7000

Intervening Zone 7000 is currently 7 T/yr above the Quantitative TOC. That number will be reduced by 6 T/yr per the model output. This value is within the margin of error of the model and is, in fact, assumed to be within the range of model 'noise' or the variability that comes from calculations within the model. Thus, this benefit of sediment reduction from the project is likely to result in a value that is within the variability of the TOC itself.

4.3 Total Watershed Sediment Yields

Figure 7 illustrates the comparison of Proposed Project (Alternative 1) and Alternatives 3, 4, 5, and 6 total watershed sediment yields against existing sediment yield and Total Watershed TOCs. The potential impacts from project alternatives are discussed below according to watershed.



	Baseline	TOC	Project	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
INT 7000	361	355	356	361	357	348	355	355
Madden	1036	1085	1002	1036	1002	957	1002	1002
Homewood	906	955	877	906	855	892	862	862
Quail	409	462	407	409	406	393	406	406
Combined	2712	2857	2642	2712	2620	2590	2625	2626

Figure 7. Total Watershed Sediment Yield vs. Total Watershed TOC

4.3.1 Homewood Creek Watershed

The sediment yield for current conditions in the entire Homewood Creek watershed is below the TOC by 49 T/yr. The Project further reduces that value to 78 T/yr.

4.3.2 Madden Creek Watershed

Madden Creek watershed current conditions, when considered as a whole, is below the quantitative TOC by 49 T/yr also. Largely this is due to large tracts of intact land outside of HMR boundaries to the north which is managed by the USFS. Implementation of the Project estimates a 34 T/yr reduction below existing conditions and an 83 T/yr reduction below baseline.

4.3.3 Quail Lake Creek Watershed

Quail Creek watershed is modeled to be 53 T/yr below the TOC and 55 T/yr below the TOC following Project implementation. Again, Quail Creek watershed will not be impacted by the project itself but will benefit from restoration efforts in the watershed associated with project commitments.

4.3.4 Intervening Zone 7000

Intervening Zone 7000, while not directly connected to a stream, is the one area (not strictly a 'watershed' in the classic sense) that will remain at or slightly above the quantitative TOC following implementation of the Project. The Project, as modeled, will reduce sediment by 5 T/yr below existing conditions and within 1 T/yr of the TOC. As previously stated, this small amount is expected to be within both the margin of error and the model 'noise'. Note that Intervening Zone 7000 does not use any of the qualitative assessment methodologies since there is no stream that drains this area.

4.4 Qualitative TOC Discussion

As described in Section 2, surface water quality, stream conditions, and other watershed indicators were consulted in the development of the Project Area and Total Watershed TOCs. Results and conclusions for the qualitative TOC elements are summarized in the following sections.

4.4.1 Stream Assessment Conclusions

The stream condition analyses did not indicate a clear degradation trend in any of the watersheds. The analysis methodologies were not completely appropriate for high gradient mountain streams; however, local professionals were able to interpret the streams and stream assessment data and conclude that, while HMR streams are not in pristine condition, they do not show signs of positive feedback loop types of degradation. Most of the accelerated erosional signatures are likely from significant recent runoff years (1997 and 2005) and not from ongoing degradation. Thus, the stream assessment data and interpretations do not suggest that the streams have reached a threshold of concern.

4.4.2 Surface Water Quality Data

Surface water quality data collected between 1995 and 2008 does not indicate any sort of trend, either downward or upward, for TSS, TN or TP. It is difficult to determine watershed response to precipitation events. In order to determine those responses, a data set that includes near continuous monitoring for at least 20 years is needed and that type of data simply doesn't exist in the Lake Tahoe Basin except for a very small number of USGS monitoring sites. However, the mean of monthly means data presented here is a standard in much of the United States, and therefore is useful for comparison and potential long-term trend analysis.

There is no clear trend indicated in this data set, except perhaps that P is higher above the project area and decreases in every case as water in the two monitored streams moves through the project area. Therefore, the water quality data does not indicate that surface water quality of the project area streams is at or near a threshold of concern.

Oil and grease are the other pollutant types that have a reasonable potential to harm beneficial uses. There are two main pathways for oil and grease to enter surface waters. The first is from highway legal vehicles, such as cars and trucks. The second is from accidental spills from snow grooming and equipment maintenance.

Under existing conditions the North and South Base areas are dominated by parking lots for private vehicles. Oil separators are installed in both areas to remove oil and grease from stormwater. The HMR maintenance facility is located in the southern end of the south base area. A spill of oil or grease here could quickly enter surface water from the storm drains. It is possible that a large spill could overwhelm the oil separators.

As part of the Proposed Project and Alternatives most of the parking (95%) in the North and South Base areas will be underground. These underground parking areas eliminate most of the current potential for outflow of oil and grease and make the capture of oil and grease easier since rainfall cannot flush oil and grease into surface water drainages before containment. In addition, spills within underground parking areas can be contained quickly. For above ground parking, high-quality sand oil separators will prevent oil and grease from entering surface waters.

Snow grooming machine parking and equipment maintenance will move to the Mid-Mountain. The construction of the Mid-Mountain maintenance facility will include systems to capture oil and grease spills. The facility is located far from surface waters and much farther from Lake Tahoe, making the probability of any oil and grease reaching the surface waters and Lake Tahoe much lower.

Alternative 4 divides the resort into 20 residential parcels. Oil and grease spill prevention and treatment are not required for residential parcels. The risk of oil and grease spills is assumed to be the same as other residential parcels around the region. However, very little actual data or understanding is available on the impacts of private homes on inputs of oil and grease to storm drain or sewer systems.

4.4.3 Other Watershed Indicators

Other watershed indicators, including visual assessment associated with Waste Discharge Requirement inspections suggest that some accelerated erosion is occurring within the project area. Ongoing use of roads and other facilities creates some amount of erosion above 'background' or undisturbed conditions. However, there is no evidence that suggests that this situation is intensifying or is at a level that is considered on an upward self-perpetuating trend. Old access roads that are spontaneously revegetating suggest that parts of the watersheds are, to a degree, moving toward more stability. Therefore, the combination of other watershed indicators that have been assessed do not indicate that the project area watersheds have reached a critical threshold of concern.

4.5 Conclusions – Project Area

- Sediment yields are one element of the overall TOC and must be considered with other specific elements in order to determine whether there are clear indications of TOC exceedance.
- Project Area and Total Watershed TOCs are more conservative (lower) that those developed under a 2007 Soil Survey TOC or a IPES-based TOC (see Appendix X for alternative TOC analyses).
- Existing sediment yields do not show a clear exceedance of the TOC, given that the sediment yields are within the statistical margin of error of the model and analysis.
- Surface water quality, stream conditions, and other watershed indicators do not show clear evidence that HMR watersheds are approaching or exceeding qualitative threshold of concern indicators.
- The HMR CWE analysis suggests that activities undertaken under all Alternatives except the no project alternative (Alternative 2) will reduce sediment yields within the project area to the benefit of the total watersheds regardless of reasonably, foreseeable future actions in the area.

4.6 Conclusions – Total Watershed

Whole watershed sediment yield data as well as other watershed indicator conclusions are identical to the project area conclusions with the exception that when the whole watershed are considered, the margin between the TOC and each project alternative sediment yield is greater or more beneficial, with the exception of Intervening Zone 7000 which still shows a decrease in sediment yield. Thus in general, this CWE evaluation suggests that: 1) the Project will not clearly exceed individual watershed TOCs and 2) the proposed Project reduces sediment yield by an estimated total of between 1.7 and 33.9 T/yr depending on watershed and 69 T/yr for all watersheds combined.

Section 5: Monitoring Plan Requirements

5.1 Background

CWE studies are designed to identify sediment loads and qualitative thresholds beyond which disturbance should not take place. However, as stated previously, these studies provide a hypothesis from which to develop a more complete understanding of watershed conditions. Monitoring is a critical component of understanding actual field conditions. This ongoing information gathering will inform the accuracy of the modeling efforts of the TOC and CWE sediment yields, and how it may or may not impact future development. HMR has been leading monitoring efforts in a number of ways over the past several years. First, nearly all of HMRs restoration efforts have been intensively monitored for sediment, cover, vegetation and soil nutrients conditions. The information gained has helped develop a greater understanding of treatment effects and sediment reduction impacts of restoration treatments in general. Further, HMR has partnered with IERS and Lahontan Regional Water Quality Control Board to intensively monitor stream flows and surface water quality in an effort to enhance TMDL implementation potential. This information will be some of the most thorough water quality monitoring in a privately held watershed in the Lake Tahoe Basin. Thus, HMRs commitment to monitoring has already been demonstrated and is likely the most comprehensive soil and erosion monitoring yet implemented on private property in the Lake Tahoe Basin. All of this monitoring has been put into place in an effort to better understand the impacts from both construction and restoration. The intent of the overall monitoring efforts at HMR is to redevelop while reducing the overall environmental impacts from ski area operations. The primary method of understanding whether this goal can be achieved is through current and other types of ongoing monitoring.

The monitoring approach for the Project will focus on continuing to gather data and information that can be used to identify and address the sources of water quality impairment (and improvement) in a timely manner and can be used to improve environmental and cost effectiveness of treatments. Specific monitoring methods are described below. The HMR CWE calibration monitoring will consist of the following:

1. Ongoing Evaluation of the TOC;
2. Restoration Project/Mitigation Effectiveness Monitoring;
3. Visual Inspections of permanent BMPs and LID bioretention areas; and
4. Surface Water Quality Sampling and Report for Updated WDRs;

5.2 Ongoing Evaluation of the TOC

5.2.1 Waste Discharge Requirement Monitoring

WDR have been established for HMR that require weekly water quality sampling at four creek stations and a number of parking lot locations during snowmelt periods from April until snowmelt ends, typically in May or June. The Updated WDRs are expected to require spring runoff monitoring and possibly expanded storm event monitoring. The purpose of this sampling is to: 1) determine stream water quality above and below the project area in an attempt to determine watershed impacts of ski area operations on stream water quality, and 2) determine water quality impacts of vehicles, especially relative to oil and grease, parking areas, and other base facility operations, into runoff infrastructure. This monitoring data will be included in a report that also describes on-mountain observed erosion issues and approaches for addressing those issues. This report is prepared twice per season and submitted to the Lahontan. It is possible that this monitoring of surface waters draining the watershed could be used to detect large-scale disturbance and changes in the watershed, and therefore could help identify if/when the TOC has been exceeded. However, changes would have to be significantly larger than historical variability in measurements and climate in order to indicate a cause for concern.

5.2.2 State 319 Grant Monitoring

In addition to the monitoring and reporting completed for the WDR, HMR continues to expand a targeted watershed restoration and monitoring program with the support of EPA 319 grant funding and HMR match funding. This project (known as the Lake Tahoe TMDL Targeted Implementation and Assessment Project) includes installation of water quality monitoring instrumentation that will enable continuous measurement of stream flow and turbidity in the Homewood Creek watershed for the duration of this grant (May 2009 – December 2012). Additionally, grab samples will be collected at each station a minimum of once per month during low-flow periods (July – March) and a minimum of weekly during snowmelt periods (approx. April – June). Collected water samples will be analyzed for particle-size distribution (PSD) and total suspended sediment (TSS). Laboratory measured TSS values will be correlated with sensor-determined turbidities to estimate continuous TSS concentrations at each monitoring station. Collection of continuous turbidity readings and stream flow, as well as discrete grab sampling for PSD and TSS, will allow for the assessment of the cumulative effects of water quality improvement projects on watershed-wide sediment yields. If significant changes are detected as a result of road restoration, this information can be used to evaluate the TOC. Again, changes would have to be significantly larger than historical variability in measurements and climate to attribute the results to particular actions.

This TMDL monitoring program is also developing adaptive management strategies based on monitoring data and the adaptive management process as outlined in the Sediment Source Control Handbook (Hogan and Drake, 2009;

http://www.sbcouncil.org/pdf/SSCH_second%20print%20run.pdf). The efforts undertaken at HMR to reduce sediment delivery and restore portions of the watershed will be described and used as a model for monitoring and implementation of TMDL strategies for upland areas throughout the Lake Tahoe basin.

5.2.3 Restoration Project/Mitigation Effectiveness Monitoring

HMR has been engaged in the removal/restoration of underutilized roads on their property and quantitative monitoring of project effectiveness since 2006. Two complimentary monitoring packages are being used to directly measure the sediment source control effectiveness of on-mountain restoration projects: 1) rainfall and runoff simulation, and 2) soil and vegetation monitoring. Each package is a collection of individual measurements, which are described below. This integrated monitoring approach has already set the standard for upland restoration project effectiveness monitoring in the Lake Tahoe Basin. With funding assistance from the recently awarded 319 grant, HMR intends to continue monitoring and reporting on the effectiveness of its restoration efforts.

Rainfall and Runoff Simulation: these techniques are used to produce artificial rainfall or runoff (overland flow) depending on site characteristics. By simulating hydrologic events, one can directly measure runoff and infiltration rates and sediment yields (i.e. erodibilities) from treatment and reference areas.

Soil and Vegetation Monitoring: This process includes direct measurement of key erosion variables such as surface cover, vegetation species cover and composition, soil nutrient content, soil density, soil physical characterization, soil moisture and solar input. These soil and vegetation measurements are a critical complement to the rainfall and runoff simulations described above, as they provide valuable information about the ecological "capital", resilience and sustainability of a site and that site's ability to resist erosive forces, support habitat, and respond to disturbance. Data from these monitoring efforts are directly improving the precision of future restoration as well as modeling efforts.

5.2.4 Visual Inspections

Inspections and reporting will be conducted at regular intervals, once in the spring and once in the fall, as part of HMR's Waste Discharge Permit requirements (currently in revision). Inspections will focus on known sediment source areas such as unpaved roads, parking lots and other impervious surfaces, and recently disturbed and/or treated areas. Visual inspections will assess the effectiveness of maintenance activities at protecting against pollutant discharges and maintaining proper BMP function. Any identified erosion or pollutant discharge issues will be addressed, documented, and reported to the Lahontan on a semi-annual basis.

Table 10. Summary of monitoring methods

Monitoring Method	Frequency	Purpose	Relationship to the TOC and WDR
Grab samples (TSS and PSD)	Weekly (during snowmelt period)	To assess in-stream water quality impacts of facilities, operations, maintenance, and restoration/mitigation projects	Part of the WDR to evaluate discharge against standards
Stream flow	Continuous	To measure seasonal changes in stream flow in order to determine total sediment load	Further refinement of hydrology calculations
Turbidity	Continuous	To determine total sediment yield (correlated with TSS)	To determine total sediment yield (correlated with TSS)
Soil and vegetation	Pre-project and 1 year post-project	To directly measure indices of site sustainability at restoration/mitigation project sites	Estimate the value of restoration projects for LSPC model analysis
Rainfall and/or runoff simulation	Pre-project and 1 year post-project	To directly measure yield reductions from restoration/mitigation project sites	Estimate the value of restoration projects for LSPC model analysis
Visual inspections	Semi-annual (spring and fall)	To identify, address, and document sources of water quality impairment (and improvement)	To make sue that all PMB are functioning well

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The Homewood Mountain Resort CWE Appendices

Appendix A: CWE Supporting Tables, Maps and Descriptions

TMDL and LSPC Supporting Information

Box A1 TMDL Land Use Codes Defined

The TMDL Land Use codes are used in this document to allow for critical review of the analysis. The following list defines the land use codes.

TMDL Code	Land Use
Residential_SFP	Pervious Areas of Single Family Homes
Residential_MFP	Pervious Areas of Multi-Family Units
CICU-Pervious	Pervious Areas of Commercial or Utility
Ski_Runs-Pervious	Ski Runs
Veg_EP1	Un-impacted Vegetation Class 1
Veg_EP2	Un-impacted Vegetation Class 2
Veg_EP3	Un-impacted Vegetation Class 3
Veg_EP4	Un-impacted Vegetation Class 4
Veg_EP5	Un-impacted Vegetation Class 5
Veg_Recreational	Impacted Forest Area such as campgrounds
Veg_Burned	Forested Areas that have recently burned
Veg_Harvest	Forested Areas that have recently been logged
Veg_Turf	Turf Playing Fields
Water_Body	Lake
Residential_SFI	Impervious Areas of Single Family Homes
Residential_MFI	Impervious Areas of Multi-Family Units
CICU-Impervious	Impervious Areas of Commercial or Utility
Roads_Primary	Highways
Roads_Secondary	Residential and Smaller Paved Roads
Roads_Unpaved	Unpaved Roads

Table A-1 Modified Existing Condition Land Use from TMDL model.

Land Use	Location	Total Area (m^2) Intervening Area #7	Madden Watershed	Homewood Watershed	Quail Watershed
CICU-Impervious	In Project	14,459 (155,635 ft^2)		4,111 (44,250 ft^2)	
	Out of Project	35,797 (385,316 ft^2)		657 (7,072 ft^2)	
CICU-Pervious	In Project	2,143 (23,067 ft^2)		571 (6,146 ft^2)	
	Out of Project	59,399 (639,366 ft^2)		6,511 (70,084 ft^2)	
Residential_MFI	In Project				
	Out of Project	71,066 (764,948 ft^2)	130 (1,399 ft^2)	96 (1,033 ft^2)	411 (4,424 ft^2)
Residential_MFP	In Project	38 (409 ft^2)			
	Out of Project	263,949 (2,841,123 ft^2)	2,700 (29,063 ft^2)	1,570 (16,899 ft^2)	730 (7,858 ft^2)
Residential_SFI	In Project			11 (118 ft^2)	
	Out of Project	257,589 (2,772,665 ft^2)	1,013 (10,904 ft^2)	2,106 (22,669 ft^2)	11,394 (122,644 ft^2)
Residential_SFP	In Project	64 (689 ft^2)		4 (43 ft^2)	
	Out of Project	1,489,892 (16,037,064 ft^2)	15,716 (169,166 ft^2)	27,664 (297,773 ft^2)	55,617 (598,656 ft^2)
Roads_Primary	In Project	199 (2,142 ft^2)			
	Out of Project	88,793 (955,760 ft^2)	1,050 (11,302 ft^2)	1,476 (15,888 ft^2)	739 (7,955 ft^2)
Roads_Secondary	In Project	2,910 (31,323 ft^2)	157 (1,690 ft^2)	7,328 (78,878 ft^2)	
	Out of Project	407,056 (4,381,514 ft^2)	2,585 (27,825 ft^2)	6,209 (66,833 ft^2)	17,834 (191,964 ft^2)
Roads_Unpaved	In Project	22,768	52,082	82,017	17,375

		Total Area (m^2)			
		(245,072 ft^2)	(560,606 ft^2)	(882,823 ft^2)	(187,023 ft^2)
	Out of Project	16,878 (181,673 ft^2)	2,053 (22,098 ft^2)	2,480 (26,694 ft^2)	11,178 (120,319 ft^2)
Ski_Runs-Pervious	In Project	226,543 (2,438,489 ft^2)	573,016 (6,167,893 ft^2)	434,296 (4,674,723 ft^2)	37,282 (401,300 ft^2)
	Out of Project	21,519 (231,629 ft^2)	40,017 (430,739 ft^2)	4,877 (52,496 ft^2)	
Veg_Recreational	In Project				
	Out of Project	11,697 (125,905 ft^2)			
Veg_Unimpacted EP-2	In Project	345 (3,714 ft^2)	96 (1,033 ft^2)	13,350 (143,698 ft^2)	86,781 (934,103 ft^2)
	Out of Project	448,010 (4,822,340 ft^2)	160,462 (1,727,199 ft^2)	33,030 (355,532 ft^2)	749,437 (8,066,872 ft^2)
Veg_Unimpacted EP-3	In Project	72,940 (785,120 ft^2)	190,979 (2,055,681 ft^2)	248,493 (2,674,756 ft^2)	484,186 (5,211,735 ft^2)
	Out of Project	2,250,372 (24,222,803 ft^2)	2,407,712 (25,916,396 ft^2)	191,673 (2,063,151 ft^2)	1,207,834 (13,001,017 ft^2)
Veg_Unimpacted EP-4	In Project	126,117 (1,357,512 ft^2)	569,362 (6,128,562 ft^2)	1,240,264 (13,350,091 ft^2)	253,975 (2,733,764 ft^2)
	Out of Project	1,057,093 (11,378,454 ft^2)	1,087,123 (11,701,695 ft^2)	204,214 (2,198,141 ft^2)	797,571 (8,584,983 ft^2)
Veg_Unimpacted EP-5	In Project		7,576 (81,547 ft^2)	94,453 (1,016,684 ft^2)	41,815 (450,093 ft^2)
	Out of Project		151,195 (1,627,449 ft^2)	1,799 (19,364 ft^2)	713 (7,674 ft^2)
Veg_Unimpacted EP-UNK	In Project		531 (5,716 ft^2)		2,604 (28,029 ft^2)
	Out of Project	34,802 (374,606 ft^2)	706 (7,599 ft^2)		45 (484 ft^2)
Water_Body	In Project		26,182 (281,821 ft^2)		56,287 (605,868 ft^2)
	Out of Project	60,325 (649,332 ft^2)	2,821 (30,365 ft^2)		
Total		**7,042,763** (75,807,670 ft^2)	**5,295,264** (56,997,747 ft^2)	**2,609,260** (28,085,841 ft^2)	**3,833,808** (41,266,766 ft^2)

Table A-2 Summary of Land Uses Converted to Unpaved Roads in Upper Watershed.

WATERSHED	Land Use	Location	Area Replaced with Unpaved Road (m^2)
INT ZONE 7	Residential_SFP	In Project	16 (172 ft^2)
INT ZONE 7	Residential_SFP	Out of Project	629 (6,770 ft^2)
INT ZONE 7	Residential_SFI	Out of Project	332 (3,574 ft^2)
INT ZONE 7	Residential_MFP	Out of Project	18 (194 ft^2)
INT ZONE 7	CICU-Pervious	Out of Project	528 (5,683 ft^2)
INT ZONE 7	CICU-Impervious	In Project	5 (54 ft^2)
INT ZONE 7	CICU-Impervious	Out of Project	36 (388 ft^2)
INT ZONE 7	Roads_Secondary	In Project	58 (624 ft^2)
INT ZONE 7	Roads_Secondary	Out of Project	396 (4,263 ft^2)
INT ZONE 7	Ski_Runs-Pervious	In Project	4,604 (49,557 ft^2)
INT ZONE 7	Ski_Runs-Pervious	Out of Project	1,429 (15,381 ft^2)
INT ZONE 7	Veg_Unimpacted EP-2	Out of Project	1,478 (15,909 ft^2)
INT ZONE 7	Veg_Unimpacted EP-3	In Project	329 (3,541 ft^2)
INT ZONE 7	Veg_Unimpacted EP-3	Out of Project	949 (10,215 ft^2)
INT ZONE 7	Veg_Unimpacted EP-4	In Project	3,921 (42,205 ft^2)
INT ZONE 7	Veg_Unimpacted EP-4	Out of Project	1,194 (12,852 ft^2)
MADDEN CREEK	Water_Body	In Project	828 (8,913 ft^2)
MADDEN CREEK	Ski_Runs-Pervious	In Project	5,381 (57,921 ft^2)
MADDEN CREEK	Veg_Unimpacted EP-3	In Project	1,004 (10,807 ft^2)
MADDEN CREEK	Veg_Unimpacted EP-3	Out of Project	665 (7,158 ft^2)
MADDEN CREEK	Veg_Unimpacted EP-4	In Project	5,603 (60,310 ft^2)
MADDEN CREEK	Veg_Unimpacted EP-5	In Project	313 (3,369 ft^2)
MADDEN CREEK	Veg_Unimpacted EP-UNK	In Project	7 (75 ft^2)
HOMEWOOD CREEK	Residential_MFP	Out of Project	75

WATERSHED	Land Use	Location	Area Replaced with Unpaved Road (m^2)
			(807 ft^2)
HOMEWOOD CREEK	Residential_MFI	Out of Project	1 (11 ft^2)
HOMEWOOD CREEK	Roads_Secondary	Out of Project	183 (1,970 ft^2)
HOMEWOOD CREEK	Ski_Runs-Pervious	In Project	11,696 (125,895 ft^2)
HOMEWOOD CREEK	Ski_Runs-Pervious	Out of Project	135 (1,453 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-2	In Project	991 (10,667 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-2	Out of Project	520 (5,597 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-3	In Project	4,275 (46,016 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-3	Out of Project	130 (1,399 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-4	In Project	27,836 (299,624 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-4	Out of Project	491 (5,285 ft^2)
HOMEWOOD CREEK	Veg_Unimpacted EP-5	In Project	2,645 (28,470 ft^2)
QUAIL CREEK	Ski_Runs-Pervious	In Project	754 (8,116 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-2	In Project	591 (6,361 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-2	Out of Project	963 (10,366 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-3	In Project	4,560 (49,083 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-3	Out of Project	1,874 (20,172 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-4	In Project	2,950 (31,754 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-4	Out of Project	271 (2,917 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-5	In Project	936 (10,075 ft^2)
QUAIL CREEK	Veg_Unimpacted EP-UNK	In Project	151 (1,625 ft^2)
		TOTAL	**91,751** (987,600 ft^2)

Watershed Size

The project area contains parts of the Homewood Creek, Madden Creek, and the Quail Lake Creek watersheds. Portions of the South and North Base areas are contained within Intervening Area #7 (See Figure A1). For initial modeling efforts, all of Intervening zone 7 was modeled in order to remain consistent with the TMDL approach. In the TOC modeling, only those portions of Intervening zone 7 (also referred to as INT 7000 in some maps and documents) that were contiguous with the project area were modeled. The sizes of each watershed and the portions within the project area are defined in Table A2.

(Please note: some entities refer to Homewood Creek by a different name – Ellis Creek. For this document, the name Homewood Creek was used).

Table A3. Size of HMR Watersheds

Watershed	TMDL Watershed #	Area (m^2)[1] Full Watershed	Area (m^2)[1] Project Area in Watershed	% of Watershed within Project Area
Intervening Area #7	7000	7,041,530 (75,794,398 ft^2) (1,740ac)	469,435 (5,052,956 ft^2) (116ac)	7%
Madden Creek	7020	5,297,335 (57,020,039 ft^2) (1,309ac)	1,420,446 (15,289,553 ft^2) (351ac)	27%
Homewood Creek	7030	2,610,222 (28,096,196 ft^2) (645ac)	2,124,600 (22,869,004 ft^2) (525ac)	81%
Quail Lake Creek	7040	3,832,373 (41,251,320 ft^2) (947ac)	979,339 (10,541,517 ft^2) (242ac)	26%
Total		**18,777,413 (202,118,391 ft^2) (4,640ac)**	**4,993,821 (53,753,042 ft^2) (1,234ac)**	**27%**

[1] The GIS files within the LSPC model use metric units. This convention is used in this document. Values provided in the narrative sections have English Units within parenthesis.

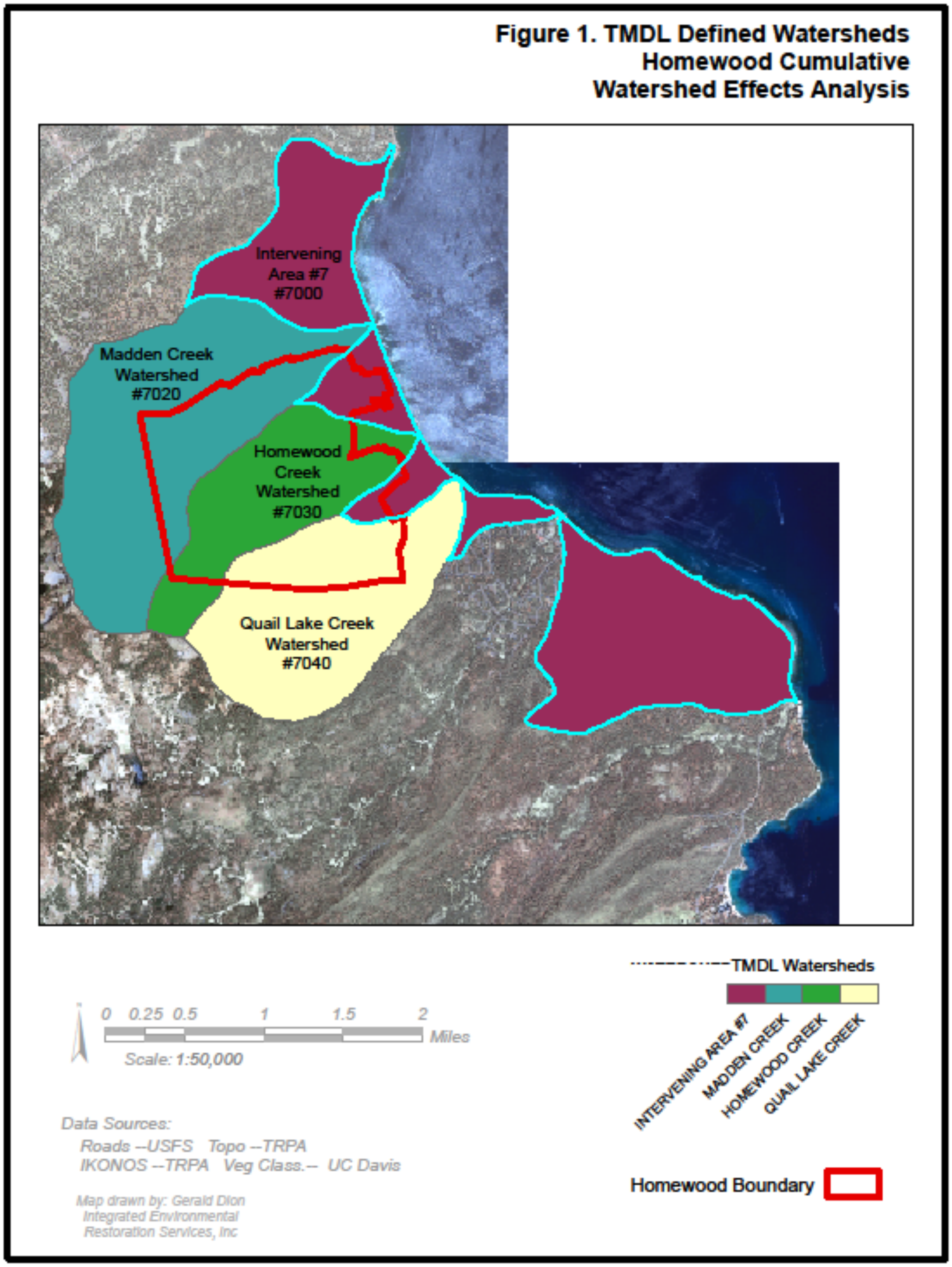

Figure A1: TMDL Defined Watersheds

Watershed Characteristics

Soil Map Units within the Project area

When addressing erosion concerns, the origin (parent material) of the soil is important. The Natural Resources Conservation Service (NRCS) produces maps of the soils found in a given area. These maps are a collection of delineated areas called "Map Units," and are collections of described soil types. Map units are used to describe the properties and origin of soil on a watershed or larger scale. As soil genesis is generally an element in describing map units, this tool is helpful in identifying the soil parent material. The NRCS has classified and mapped the soil conditions within the HMR watersheds in two separate soil surveys. The original soil survey was completed in 1974 (Rogers, 1974) and was of a relative low resolution due to funding and time constraints. A new, more complete survey was completed in 2007 (NRCS, 2007). Slope and watershed attributes discussed here are from the 2007 survey. Most of the soils within these watersheds are derived from volcanic parent material. However, there are a few areas mapped as a mixture between volcanic and granitic parent material.

Figure A2 illustrates areas derived from volcanic or granitic parent material. Table A2 summarizes the acreage of map units by parent material. It is important to know the soil parent material, as volcanically-derived soil produces more sediment than granitically-derived soil (Grismer, M.E. and M.P. Hogan. 2005). A parameter in the LSPC model is the total percentage of each watershed in granitic or volcanically-derived soil.

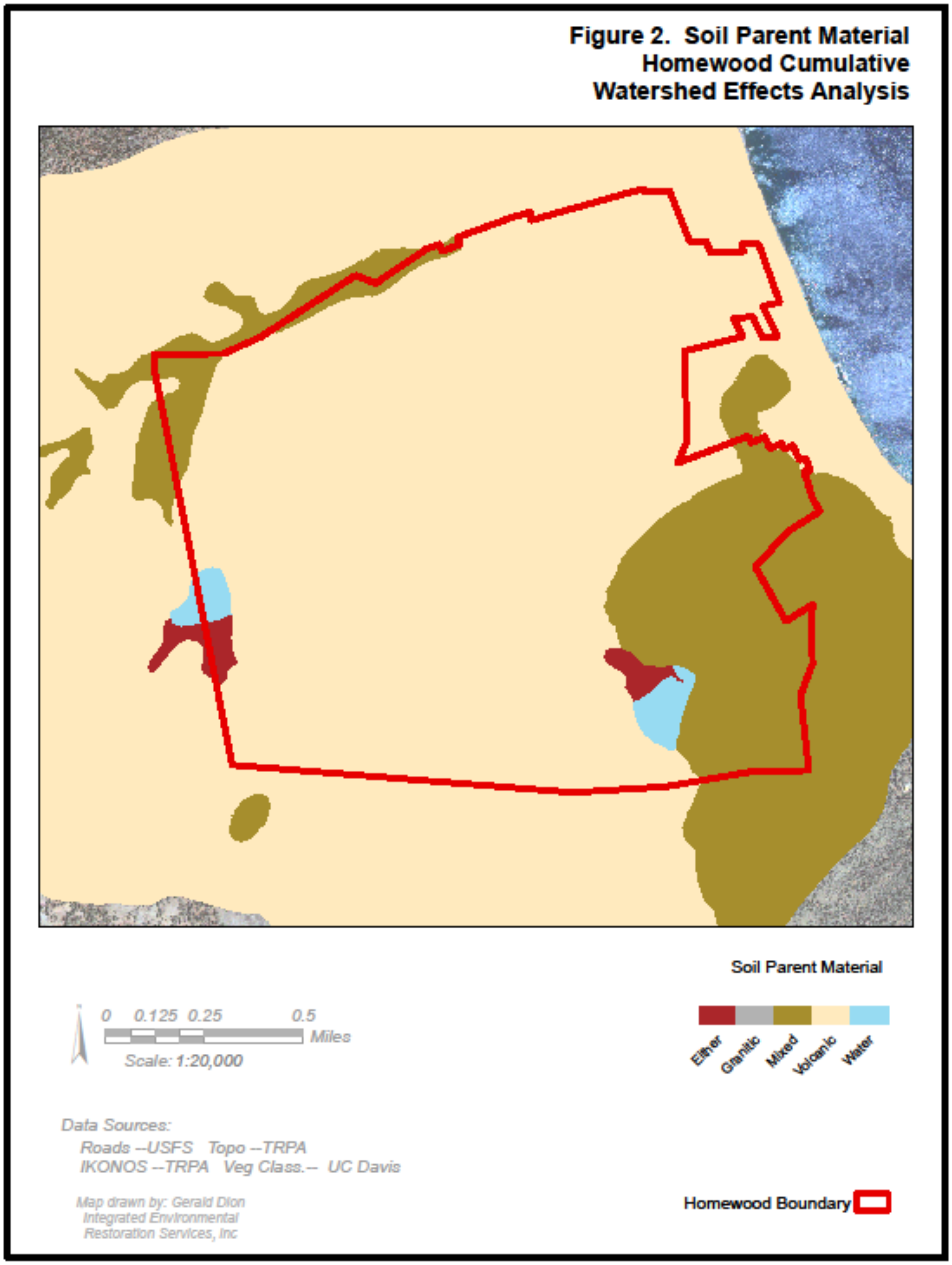

Figure A2: Soil Parent Material

Table A4. Soil Parent Material by Watershed

Watershed	Soil Parent Material (m^2)			
	Volcanic	Mixed	Either[1]	**Total[2]**
Intervening Area#7	331,842 (3,571,918 ft^2)	137,593 (1,481,039 ft^2)	--	469,435 (5,052,956 ft^2)
Madden Creek	1,258,572 (13,547,156 ft^2)	117,359 (1,263,242 ft^2)	24,281 (261,359 ft^2)	1,396,165 (15,028,195 ft^2)
Homewood Creek	1,902,023 (20,473,205 ft^2)	222,577 (2,395,799 ft^2)	--	2,124,600 (22,869,004 ft^2)
Quail Lake Creek	34,185 (367,964 ft^2)	368,264 (3,963,961 ft^2)	28,328 (304,920 ft^2)	934,824 (10,062,362 ft^2)
Totals	**4,026,622** (43,342,198 ft^2)	**845,793** (9,104,040 ft^2)	**52,609** (566,279 ft^2)	**49,213,821** (529,733,161 ft^2)

[1] These areas are mapped as having either volcanic or granitic parent material.

[2] The difference between the Table 3 area total and the area total in Table 2 can be accounted for by the two lakes within the watersheds, which encompass 72,843m2 (784,076 ft2) (18 acres).

Geological Units with the Project area

The underlying geology within the HMR watersheds is mostly volcanic in origin and has been modified by past glaciers (see Figure A3). Within the Quail Lake watershed exists soils of both granitic and sedimentary origin. The underlying geology helps define the soil parent material, which is a parameter in the LSPC model.

Table A5. Geologic Units by Watersheds

Geologic Symbol	Geologic Unit	Volcanic or Granitic Origin
gr	Granitic Rocks	Granitic
ms	Metasedimentary Rocks	Volcanic
Ql	Older Lakebed Deposits	Mixed
Qlo	Older Lake Sediments	Mixed
Qm3	Tioga Till Glacial Moraines	Volcanic

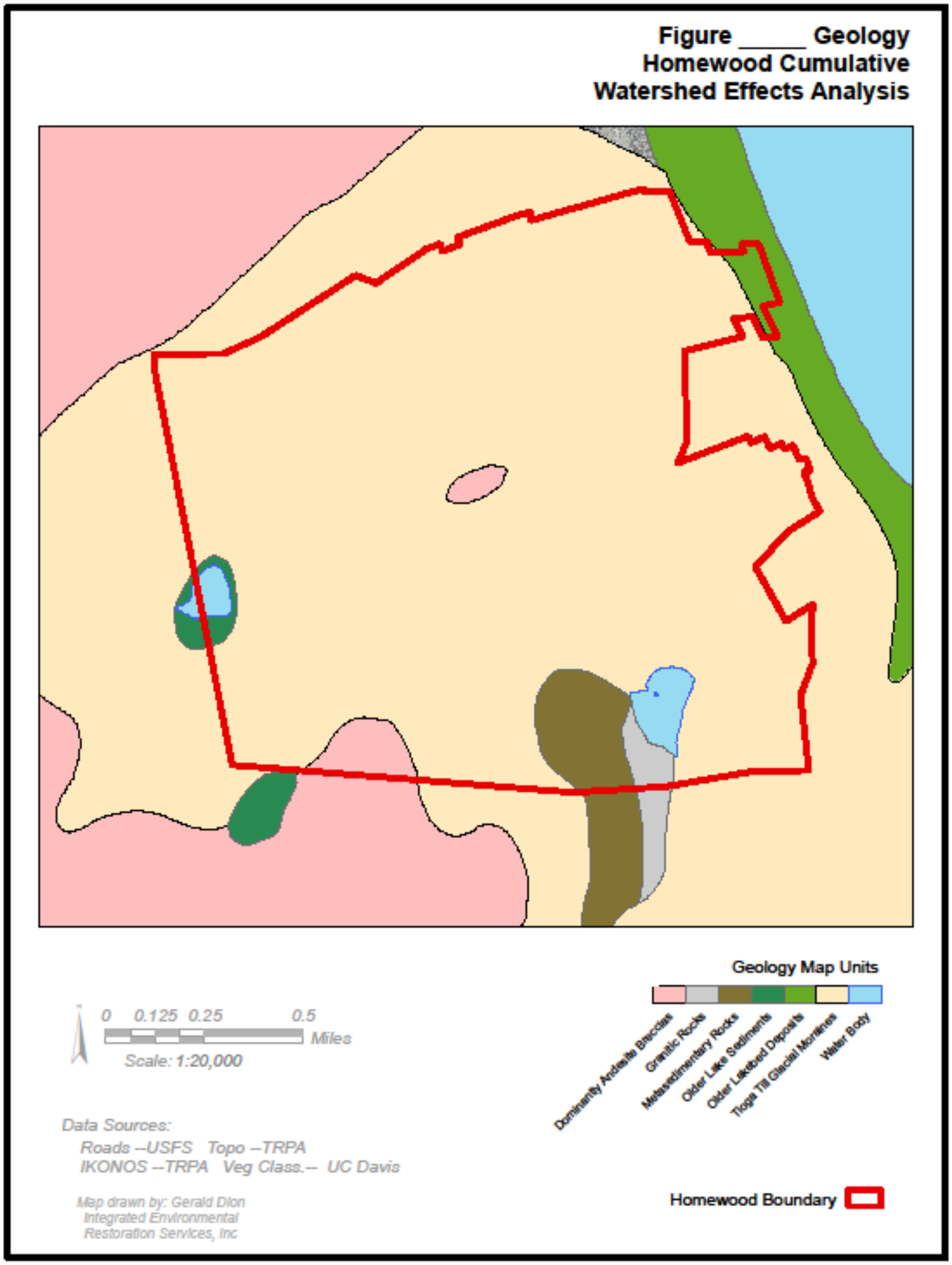

Figure A3: Geology

Average Slope and Aspect

The HMR watersheds generally drain from the southwest into Lake Tahoe, and therefore the sides of the valleys generally face (exposure) southeast and northwest (see Figures A4 and A5). The watersheds have high average slopes of between 26% and 48%. This is important because areas of steeper slope will generally produce more sediment than areas with a more gradual slope. The North and South Base areas, where most of the redevelopment is planned, is relatively flat. The mid mountain development is planned for a relatively flat ridge area that is flanked by steep (50%+ areas to the north and south.)

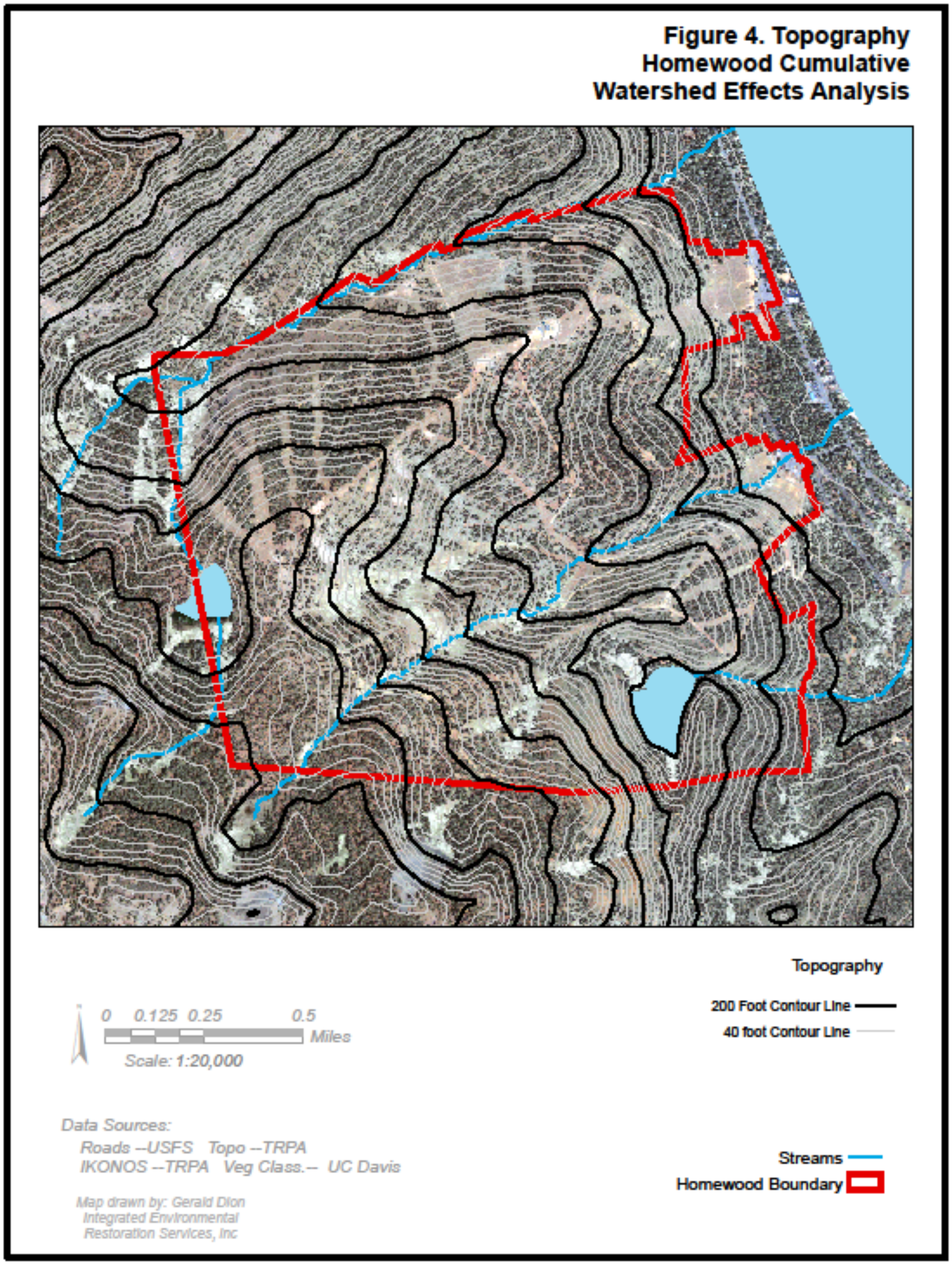

Figure A4: Topography

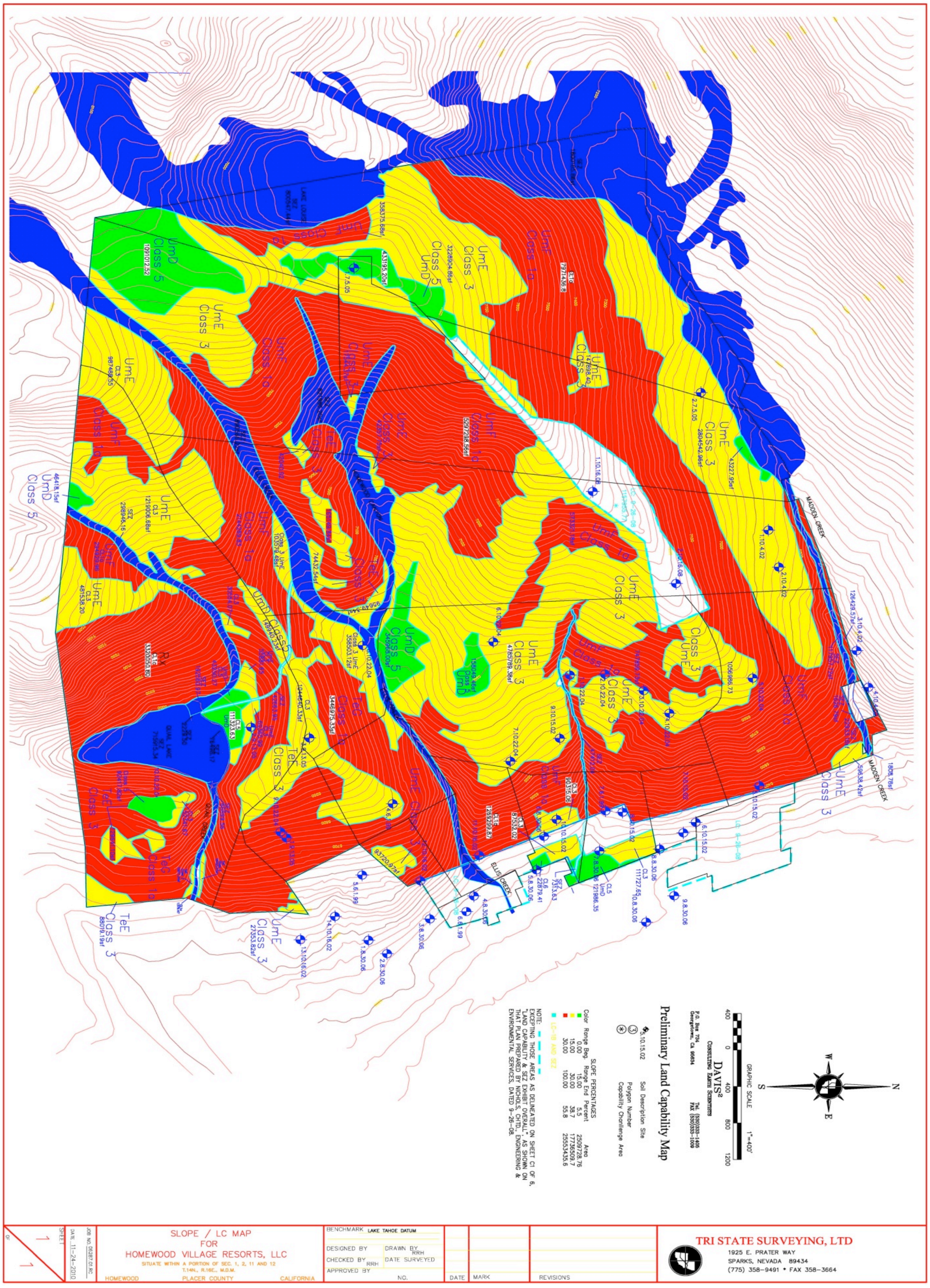

Figure A5: Average Slope. This is the 'adjusted slope phase' map used in TOC development.

Table A6. Average Slope and Aspect by Watershed

Watershed	Average Slope	General Aspect
Intervening Area #7	26%	NE
Madden Creek	48%	SE and NW
Homewood Creek	47%	SE and NW
Quail Creek	45%	SE and NW

Watershed and Land Use History

The Homewood, California area has a long history of logging, mining, vacation, and recreational use. Logging was conducted during the turn of the century to support the Comstock boom. Tahoe's only gold mine was operated adjacent to the project area. Established in 1939, it was operated into the 1940's when the value of the ore was found to be too low to be profitable. The two mine shafts are located south of Quail Lake and an open pit area is located just outside of Chamberlands. The first hotel was built in the area in 1910, and by 1960 the first rope tow was installed at Homewood, California that would be developed into HMR. There have been a number of ownership changes over the years, with the current owners (JMA Ventures) acquiring the resort in 2006. Homewood Ski Area and Tahoe Ski Bowl, former separate resorts which shared a common ridge (Rainbow Ridge), were merged into one ski area in the 1980's.

Current land use, as mapped within the TMDL GIS layer, within the project area includes developed area, roads, and ski trails. Table A7 summarizes the existing land use within the project area. Table A-1 presents a full breakdown of land uses within each project area watershed.

Table A7. Baseline/Existing Land Use by Watershed

	Summarized Baseline/Existing Land Use within the Project Area (m^2)				
Watershed	Developed Area	Roads	Ski Run/Vegetated	Water Body	**Total**
Intervening Area#7	16,187 (174,235 ft^2)	24,281 (261,359 ft^2)	424,920 (4,573,801 ft^2)	-	469,435 (5,052,956 ft^2)
Madden Creek	-	52,609 (566,279 ft^2)	1,343,556 (14,461,916 ft^2)	24,281 (261,359 ft^2)	1,420,447 (15,289,564 ft^2)
Homewood Creek	4,047 (43,562 ft^2)	89,031 (958,322 ft^2)	2,031,522 (21,867,121 ft^2)	-	2,124,600 (22,869,004 ft^2)
Quail Lake Creek	-	16,187 (174,235 ft^2)	906,496 (9,757,442 ft^2)	56,656 (609,840 ft^2)	979,339 (10,541,517 ft^2)
Total	**20,234** (217,797 ft^2)	**186,155** (2,003,756 ft^2)	**4,706,494** (50,660,280 ft^2)	**80,937** (871,199 ft^2)	**4,993,821** (53,753,042 ft^2)

Alterations to the Land Use Conditions for Analysis

To reflect the program elements for the Proposed Project and alternatives, the following alterations to existing land uses were made for the LSPC-based analysis.

Existing Conditions/Baseline Conditions

The existing conditions for this analysis is from the TMDL GIS land use dataset (2004 dataset). The area associated with each land use is summarized in Appendix A, Table A-1. Please see Hydrologic Modeling and Sediment and Nutrient Loading Estimation for the Lake Tahoe Total Maximum Daily Load Project (Lahontan 2008) for a full description of the method used for land use classification.

The TMDL assigned a specific amount of sediment delivery to the lake from each watershed. Assumptions were made about land use based on existing GIS layers. As was previously stated, field observations and measurements indicated that more dirt roads existed than were shown on the GIS layers. In order to more accurately reflect specific contributions to the sediment delivery, the TMDL GIS-derived baseline land use was modified to correct an under-counting of unpaved roads within the watersheds. These roads were undercounted in the TMDL model which was based on older maps and aerial photography. Field verification identified roads that had been built since the mid 1970's. Using the TMDL land use classification, 174,015m^2 (1,873,082 ft^2; 43 acres) of existing dirt roads were identified. However, there are an additional 91,751m^2 (987,600 ft^2; 22 acres) of dirt roads known to exist in the project area based on actual field verifications and measurements. Using the HMR GIS database (IERS, 2009), these 91,751m^2 (987,600 ft^2; 22 acres) of roads are added to the land use data layer, and 91,751m^2 (987,600 ft^2; 22 acres) of other land uses are removed.

Table A8. Baseline Annual Sediment Yield by Watershed (T/yr)

Baseline Sediment Yield	INT 7000 yield (T/yr))		WS 7020 Madden yield (T/yr)		WS 7030 Homewood yield (T/yr)		WS 7040 Quail yield (T/yr)		TOTAL Yield (T/yr)	
Subcategory Name	**In-Proj**	**Out-Proj**	**In-Proj**	**Out-Proj**	**In-Proj**	**Out-Proj**	**In-Proj**	**Out-Proj**	**In-Proj**	**Out-Proj**
Residential_SFP	0.00	20.12	0.00	0.76	0.00	1.93	0.00	2.57	0.00	25.39
Residential_MFP	0.00	9.41	0.00	0.30	0.00	0.30	0.00	0.09	0.00	10.10
CICU-Pervious	0.17	2.89	0.00	0.00	0.00	0.00	0.00	0.00	0.17	2.89
Ski_Runs-Pervious	28.76	1.87	209.85	13.28	251.18	0.98	14.48	0.00	504.27	16.13
Veg_EP1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Veg_EP2	0.00	4.14	0.00	4.30	0.84	0.86	2.94	19.11	3.78	28.41
Veg_EP3	2.26	31.27	12.65	193.85	34.49	17.38	44.52	100.70	93.92	343.20
Veg_EP4	14.50	70.56	123.91	244.48	365.49	50.92	52.29	118.03	556.19	483.98
Veg_EP5	0.00	0.00	5.72	114.15	69.52	1.32	21.06	0.36	96.30	115.83
Veg_Recreational	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
Veg_Burned	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Veg_Harvest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Veg_Turf	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Baseline Sediment Yield	INT 7000 yield (T/yr))		WS 7020 Madden yield (T/yr)		WS 7030 Homewood yield (T/yr)		WS 7040 Quail yield (T/yr)		TOTAL Yield (T/yr)	
Water_Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential_SFI	0.00	13.57	0.00	0.07	0.00	0.14	0.00	0.79	0.00	14.57
Residential_MFI	0.00	10.00	0.00	0.02	0.00	0.02	0.00	0.07	0.00	10.10
CICU-Impervious	5.82	9.92	0.00	0.00	2.10	0.23	1.05	0.12	8.97	10.27
Roads_Primary	0.26	65.48	0.00	0.93	0.00	1.38	0.00	0.60	0.26	68.38
Roads_Secondary	0.60	55.57	0.04	0.45	1.93	1.09	0.00	3.05	2.56	60.15
Roads_Unpaved	9.14	3.65	106.67	4.49	102.22	1.35	15.78	11.21	233.81	20.70
Veg_Unknown	0.00	0.92	0.04	0.06	0.00	0.00	0.10	0.00	0.14	0.99
Totals	***61.51***	***299.52***	***458.88***	***577.13***	***827.77***	***77.91***	***152.23***	***256.69***	***1500.38***	***1211.25***

From Grismer, 2010, CWE sediment output based on LSPC-TMDL coefficients

[1] See Box 3 for definitions of land use codes.

Proposed Project (Alternative 1)

The following changes to baseline conditions were made to the LSPC model parameters to represent the Proposed Project (Alternative 1).

Mid-Mountain Facilities

The Proposed Project includes a lodge and maintenance facility at the mid-mountain area. The total land use footprint is 7548m^2 (81,251ft^2), all located within the Madden Creek watershed. For the HMR CWE analysis, this area was converted from a forest land use to a commercial land use (Land use code: CICU-Impervious).

Private Townhomes

Sixteen private townhomes are added to the mountain area just south of the North Base.. A new paved road will be needed to access these townhomes. The area of this paved road is 3,461m^2 (37,254ft^2).

North Base Area

The parking structure and lodge area and associated footprint of the townhomes have a total land use footprint of 37,090m^2 (399,235ft^2). Most of this area is on previously disturbed land. Although this is a mixed-use development, only one land use maybe selected for a future condition. For the parking structure and the lodge area, the land use was changed to commercial (Land use code: CICU-Impervious). Within the North Base area, there are new access roads and parking areas. For these areas (7,832m^2 or 84,303ft^2), the land use was changed from a commercial land use to a paved secondary road land use (Land use code: Roads_ Secondary).

South Base Area

The South Base area contains two new multi-family residential buildings, a redesigned roadway, and restoration areas. The two new buildings have a total land use footprint of 13,307 m^2 (143,233ft^2). Most of this area is on previously disturbed land and was converted to multi-family residential land use. As part of the road redesign and access to the North Base townhomes, 2,248m^2 (24,197ft^2) of existing commercial land use will become a paved road (Land use code: Road_Secondary). Areas of previous urban land use (6,083m^2 or 65,477ft^2) that will be restored are reclassified to forest land use category in order to reflect high function within those lands (Land use code: EP3)[14]. Note that the LSPC model does not explicitly model riparian restoration.

Removal of Unpaved Roads in the Upper Watershed

There is currently a significant effort to remove and restore unneeded roads within the project area. Since 2006, approximately 22,337 m^2 (240,434 ft^2) of unused dirt access roads and other areas have been treated. Within the scope of the Proposed Project, a total of 46,451 m^2 (500,000 ft^2) of dirt roads and other disturbances will be removed, treated and restored. As previously described, some of these are TRPA verified roads, and some of the work is done on non-verified roads, road cut and fills, and non-road areas. Each treatment area was accurately reflected in the modeling exercise and assigned appropriate sediment values. Following the methodology outlined in the Lake Tahoe TMDL Pollutant Load Reduction Opportunities Report (Roberts, D. and J. Reuter, 2007), the restored roadways would be reclassified from a Condition Class F to a Condition Class B (shown in Table 21), which would reduce the total amount of sediment produced. For the HMR CWE analysis, the conservative value of 250,000 ft^2 of additional coverage removal is assumed. Removal of additional roadways would obviously result in increased reductions of total sediment yield.

Alternative 2 - No Project

Alternative 2 is described in the Existing Conditions/Baseline Conditions section above.

Alternative 3 - No Code Amendment for Height

The following changes to baseline conditions were made to the LSPC model parameters to represent Alternative 3.

Mid-Mountain Facilities

Alternative 3 includes a lodge and maintenance facility at the mid-mountain area, all located within the Madden Creek watershed. For the analysis, this area was converted from a forest land use to a commercial land use (Land use code: CICU-Impervious).

[1414] In this report, wherever land is reported as returned to forest, this statement is referring to a forest land use category, which is a high function category within the model but does not necessarily denote an actual forest restoration. Soil conditions will be brought back to forest soil conditions with high infiltration and organic matter.

Private Townhomes

Sixteen private townhomes are added to the mountain area just south of the North Base. A new paved road will be needed to access these townhomes. The area of this paved road is split between the Madden and Homewood Creek watersheds.

North Base Area

The parking structure and lodge area are as listed for Alternative 1. Most of this area is on previously disturbed lands. Although this is a mixed-use development, only one land use maybe selected for a future condition. For the parking structure and the lodge area the land use was changed to commercial (Land use code: CICU-Impervious). Within the North Base area, there are access roads and parking areas.

South Base Area

The South Base Area contains two new multi-family residential buildings, a redesigned roadway, and restoration areas. Most of this area is on previously disturbed lands and was converted to multi-family residential land use.

Removal of Dirt Roads in the Upper Watershed

Road removal is as described in Alternative 1.

Alternative 4 - Privatize Resort

The following changes to baseline conditions were made to the LSPC model parameters to represent Alternative 4.

Private Residences

Sixteen private residences are added to parcels within the mountain area. It is assumed that these residences would have a large footprint ($465m^2$ or $5,000ft^2$ of coverage). It is further assumed that these residences would be sited within the existing ski trails and forested areas.

Paved Access Road

It is assumed that the primary access dirt roads to the residences would be paved.

North Base Area

There are no changes in land use within the North Base area.

Alternative 5 - Urban Boundary Subdivision

The following changes to baseline conditions were made to the LSPC model parameters to represent Alternative 5.

Mid-Mountain Facilities

Alternative 5 includes a lodge and maintenance facility at the mid-mountain area as listed in the preferred alternative. This area was from converted from a forest land use to a commercial land use (Land use code: CICU-Impervious).

North Base Area

Alternative 5 includes a lodge and parking structure at the North Base. Most of this area is on previously disturbed lands. Although this is a mixed-use development, only one land use may be selected for a future condition. For the parking structure and the lodge area, the land use was changed to commercial (Land use code: CICU-Impervious). Within the North Base area there are access roads and parking areas.

South Base Area

The South Base Area is subdivided into 16 parcels and sold as residential lots. It is assumed that large multi-story homes are built on each lot, and that 163m^2 (1,750ft^2) is converted to a single-family residential land use (Land use code: Residential_SFI). The total land use footprint of these residential homes is 2,608m^2 (28,072ft^2).

Removal of Dirt Roads in the Upper Watershed

Dirt road removal is as described in the preferred alternative.

Alternative 6 - Urban Boundary Subdivision Variant

Under Alternative 6, the proposed buildings are lower in height than in Alternative 5. Residential condominiums are located in buildings adjacent to Highway 89 at the North Base, in the existing gravel parking lot area, and some in the hotel and day skier structure. The day skier parking structure and employee housing are moved from the gravel parking lot area proposed in Alternative 1 to a site adjacent to the skier services building. A new mid-mountain lodge will be the same as described for the Proposed Project. The South Base would be subdivided into 14 residential lots and one residential condominium building. A number of unused dirt access roads within the upper watersheds would be removed and restored.

Appendix B: Understanding the Beneficial Uses of Water and Protection Standards

Surface and ground waters provide beneficial uses for people, animals, plants, and industries. The State of California Water Quality Control Board (State Board) has defined the beneficial uses for surface and groundwater in almost every watershed within its jurisdiction. These beneficial uses are defined within Chapter 2 of the Water Quality Control Plan for the Lahontan Region (Lahontan Basin Plan 1995), which is a regulatory plan designed to guide the protection of water quality. Table B1 lists the beneficial uses for the three watersheds within the project area. The exact definition from the Lahontan Basin Plan for each of these uses can be found in Box 1. The three HMR watersheds are the Madden Creek, Homewood Creek, and Quail Lake Creek.

In general, for every beneficial use and water quality objective defined in the Lahontan Basin Plan there are protection standards called Water Quality Protection Criteria. The indicators of unacceptable disturbance used for this CWE analysis are defined as the water quality protection criteria taken from the Lahontan Basin Plan.

Existing and proposed activities within the project area do not directly generate chemicals or coliform organisms, or change the temperature of the surface waters. It should be noted that spills and accidents could release chemicals into surface waters, but this potential is not part of the HMR CWE analysis.

All beneficial uses described in Table B1 require protection. Two pollutant types within the project area have a reasonable potential to harm the listed beneficial uses. These pollutant types are: 1) sediment and 2) oil and grease. These two pollutants provide two different mechanisms to create impacts to beneficial uses.

The approaches used to address these two mechanisms are discussed below.

Sediment

Impacts from sediment are estimated based on the LSPC results and modification of existing land uses to proposed land uses. Section 3, entitled Analysis Methodology, contains a complete description of the methodology. The units of the annual total sediment yield are estimated in Tonnes (T). To compare the sediment yields of the Proposed Project (Alternative 1) and alternatives 3, 4 and 5 to the existing conditions (Alternative 2), the results were converted to a percent of the existing conditions. Values greater than 100% indicate an increase in erosion and values less than 100% indicate a decrease in erosion.

Oil and Grease

Section 4 provided a discussion of the treatment of vehicle generated and entrained oil and grease and provides a comparison between existing and proposed oil and grease discharges.

In order to ascertain whether these limits are being met, the standard used is spring runoff and storm event sampling by the landowner or "discharger". HMR has kept records of sampling for at least 20 years (1989 to present) and submits sampling results to Lahontan in conformance with waste discharge requirements

Table B1. Lahontan Water Quality Protection Criteria

Beneficial Use	Indicator of Unacceptable Disturbance (Water Quality Protection Criteria)
Municipal and Domestic Supply	2. California ambient water quality standards a. Total Dissolved Salts 60mg/l b. Chlorine 0.1mg/l c. Nitrogen 0.15mg/l d. Phosphorus 0.018mg/l 3. Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90th percentile value of 60 mg/L. 4. Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.
Ground Water Recharge	In ground waters designated as MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters.
Water Contact Recreation	Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.
Noncontact Water Recreation	None
Commercial and Sportfishing	High heavy metal concentrations
Cold Freshwater Habitat	Same as Spawning, Reproduction, and Development
Wildlife Habitat	None defined
Spawning, Reproduction, and Development	Species dependent standards, however lake clarity sediment protection standard would protect all fish and invertebrate species.
Suspended Sediment Objective for Lake Tahoe	Suspended sediment concentrations in streams tributary to Lake Tahoe shall not exceed a 90^{th} percentile value of 60mg/L. (Lahontan Basin Plan, 1995)

Box B1 Definitions of Beneficial Use
(Lahontan Basin Plan, 1995)

Municipal and Domestic Supply.
Beneficial uses of waters used for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Ground Water Recharge.
Beneficial uses of waters used for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Water Contact Recreation.
Beneficial uses of waters used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.

Noncontact Water Recreation.
Beneficial uses of waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.

Commercial and Sportfishing.
Beneficial uses of waters used for commercial or recreational collection of fish or other organisms including, but not limited to, uses involving organisms intended for human consumption.

Cold Freshwater Habitat.
Beneficial uses of waters that support cold water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.

Wildlife Habitat.
Beneficial uses of waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.

Spawning, Reproduction, and Development.
Beneficial uses of waters that support high quality aquatic habitat necessary for reproduction and early development of fish and wildlife.

Appendix C: TOC Supporting Documents

Figure C-1: Bailey coefficients from Bailey, 1974

Table 4. Basis of capability classification for Lake Tahoe basin lands

Capability levels	Tolerance for use	Slope percent[1]	Relative erosion potential	Runoff potential[2]	Disturbance hazards
7	Most	0-5	Slight	Low to moderately low	
6		0-16	Slight	Low to moderately low	Low hazard
5		0-16	Slight	Moderately high to high	
4		9-30	Moderate	Low to moderately low	
3		9-30	Moderate	Moderately high to high	Moderate hazard lands
2		30-50	High	Low to moderately low	
1a	Least	30+	High	Moderately high to high	High hazard lands
1b		Poor natural drainage			
1c		Fragile flora & fauna[3]			

[1] *Most slopes occur within this range. There may be, however, small areas that fall outside the range given.*

[2] *Low to moderately low – hydrologic-soil groups A and B; moderately high to high – hydrologic-soil groups C and D.*

[3] *Areas dominated by rocky and stony land.*

Table 5. — Lake Tahoe basin land area classified by capability

Land capability class	Total area		National Forest land	
	Acres	*Percent*	*Acres*	*Percent*
7	3,030	2	101	
6	8,800	4	1,144	
5	16,730	8	4,878	4
4	7,050	4	1,421	
3	12,900	6	3,471	3
2	4,770	2	2,012	2
	148,750	74	102,266	88
Total	202,030	100		100

20

Table C1: Sid Davis Calculations for Bailey 1974, adjusted for slope					
SMU	**SMU Acres**	**Capability Class**	**Allowable % Coverage**	**Acres of Coverage**	
Gr	2	1b	1	0.0	***Total Map Unit Acres***
Gr	11	1b	1	0.1	1991
Gr	6	1b	1	0.1	
Gr	8	1b	1	0.1	***Total Acres of Coverage***
Gr	1	1b	1	0.0	122.6
Gr	10	1b	1	0.1	
Lo	7	1b	1	0.1	Sq Ft
Mh	5	1b	1	0.1	5,339,149
MsE	13	1a	1	0.1	
MsG	5	1a	1	0.1	
MxF	36	1c	1	0.4	
MxF	22	1c	1	0.2	
MxF	68	1c	1	0.7	
MxF	133	1c	1	1.3	
MxF	18	1c	1	0.2	
Ra	35	1c	1	0.4	
Ra	1	1c	1	0.0	
Ra	20	1c	1	0.2	
Ra	308	1c	1	3.1	
Rx	14	1c	1	0.1	
Rx	31	1c	1	0.3	
Rx	18	1c	1	0.2	
Rx	17	1c	1	0.2	
Rx	20	1c	1	0.2	
Rx	10	1c	1	0.1	
Rx	11	1c	1	0.1	
Rx	4	1c	1	0.0	
Rx	10	1c	1	0.1	
Sm	0	1c	1	0.0	
Sm	10	1c	1	0.1	
Sm	116	1c	1	1.2	
TcB	116	5	25	29.0	
TcC	4	5	25	1.0	
TeE	43	3	5	2.2	
TeE	24	3	5	1.2	
TeG	24	1a	1	0.2	
TeG	51	1a	1	0.5	

Table C1: Sid Davis Calculations for Bailey 1974, adjusted for slope					
SMU	**SMU Acres**	**Capability Class**	**Allowable % Coverage**	**Acres of Coverage**	
TkC	135	5	25	33.8	
TkC	9	5	25	2.3	
TkC	9	5	25	2.3	
TkC	16	5	25	4.0	
TkC	23	5	25	5.8	
TkC	46	5	25	11.5	
TrF	2	1a	1	0.0	
UmD	4	5	25	1.0	
UmE	5	3	5	0.3	
UmF	9	1a	1	0.1	
UmF	42	1a	1	0.4	
WaE	31	3	5	1.6	
WBDY	2		0	0.0	
WcE	22	3	5	1.1	
WcE	85	3	5	4.3	
WcE	34	3	5	1.7	
WcF	151	3	5	7.6	
WcF	26	1a	1	0.3	
WcF	8	1a	1	0.1	
WcF	9	1a	1	0.1	
WcF	20	1a	1	0.2	
WcF	10	1a	1	0.1	
WcF	27	1a	1	0.3	
WcF	8	1a	1	0.1	
WcF	3	1a	1	0.0	
WcF	4	1a	1	0.0	
WcF	19	1a	1	0.2	

Table C2: Sid Davis Calculation table for Bailey '07					
Map Unit	**Acres**	**Land Capability**	**Percent Coverage**	**Acres Of Coverage**	
7041	6.1	7	0.30	1.82	***Total Map Unit Acres***
7122	3.1	1	0.01	0.03	1994.1
7123	24.4	1	0.01	0.24	
7131	64.7	3	0.05	3.23	***Total Acres of Coverage***
7132	5.1	1	0.01	0.05	164.57
7132	19.1	1	0.01	0.19	
7132	8.6	1	0.01	0.09	Sq ft
7151	15.9	6	0.30	4.78	7,168,542

Table C2: Sid Davis Calculation table for Bailey '07					
Map Unit	**Acres**	**Land Capability**	**Percent Coverage**	**Acres Of Coverage**	
7152	18.1	4	0.20	3.61	
7153	11.2	2	0.01	0.11	
7171	5.8	6	0.30	1.75	
7173	0.3	7	0.30	0.09	
7173	79.0	7	0.30	23.69	
7174	27.8	6	0.30	8.35	
7174	9.2	6	0.30	2.77	
7191	3.7	1	0.01	0.04	
7191	0.2	1	0.01	0.00	
7191	15.4	1	0.01	0.15	
7191	10.9	1	0.01	0.11	
7231	72.5	3	0.05	3.62	
7231	11.3	3	0.05	0.57	
7231	22.1	3	0.05	1.11	
7232	9.7	1	0.01	0.10	
7232	37.7	1	0.01	0.38	
7232	11.6	1	0.01	0.12	
7232	67.3	1	0.01	0.67	
7485	14.9	4	0.20	2.98	
7486	4.7	1	0.01	0.05	
7522	110.1	4	0.20	22.01	
7522	0.0	4	0.20	0.00	
7523	32.5	1	0.01	0.33	
7523	13.8	1	0.01	0.14	
7525	4.3	6	0.30	1.30	
7526	9.3	6	0.30	2.80	
7526	22.1	6	0.30	6.62	
7526	77.6	6	0.30	23.28	
7526	46.7	6	0.30	14.02	
9001	5.5	1	0.01	0.06	
9011	32.7	1	0.01	0.33	
9011	8.0	1	0.01	0.08	
9011	30.4	1	0.01	0.30	
9011	7.8	1	0.01	0.08	
9121	3.3	6	0.30	0.98	
9122	10.3	4	0.20	2.07	
9123	1.6	1	0.01	0.02	
9141	9.1	3	0.05	0.46	
9141	7.6	3	0.05	0.38	
9142	17.1	1	0.01	0.17	
9161	7.8	3	0.05	0.39	
9161	3.7	3	0.05	0.19	
9161	48.1	3	0.05	2.40	

Table C2: Sid Davis Calculation table for Bailey '07					
Map Unit	**Acres**	**Land Capability**	**Percent Coverage**	**Acres Of Coverage**	
9161	7.5	3	0.05	0.37	
9161	58.5	3	0.05	2.93	
9161	135.0	3	0.05	6.75	
9161	20.5	3	0.05	1.03	
9161	13.4	3	0.05	0.67	
9162	46.1	1	0.01	0.46	
9162	6.3	1	0.01	0.06	
9162	14.4	1	0.01	0.14	
9162	23.8	1	0.01	0.24	
9162	44.9	1	0.01	0.45	
9162	40.7	1	0.01	0.41	
9162	73.3	1	0.01	0.73	
9162	9.8	1	0.01	0.10	
9163	12.1	1	0.01	0.12	
9163	1.8	1	0.01	0.02	
9163	20.5	1	0.01	0.20	
9163	9.2	1	0.01	0.09	
9164	35.8	3	0.05	1.79	
9164	31.1	3	0.05	1.55	
9164	30.3	3	0.05	1.52	
9164	27.2	3	0.05	1.36	
9164	6.6	3	0.05	0.33	
9164	12.3	3	0.05	0.61	
9164	34.3	3	0.05	1.71	
9165	5.3	1	0.01	0.05	
9165	12.8	1	0.01	0.13	
9165	5.6	1	0.01	0.06	
9165	1.6	1	0.01	0.02	
9165	35.7	1	0.01	0.36	
9165	18.7	1	0.01	0.19	
9165	28.4	1	0.01	0.28	
9165	9.7	1	0.01	0.10	
9165	29.6	1	0.01	0.30	
9165	2.2	1	0.01	0.02	
9165	8.9	1	0.01	0.09	
9166	9.8	1	0.01	0.10	
9166	14.1	1	0.01	0.14	
9406	1.6	1	0.01	0.02	
W	1.4				
W	3.5				

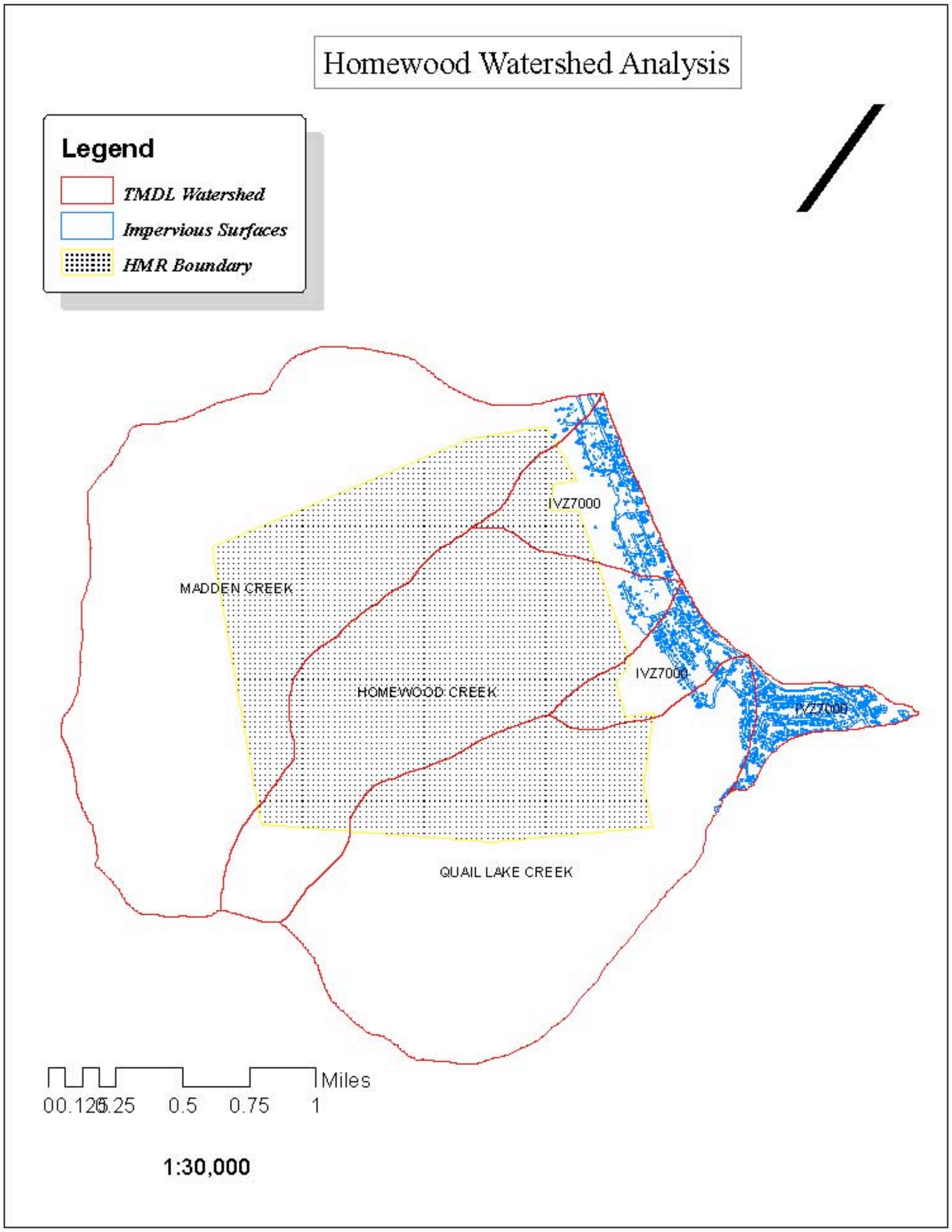

Figure C2: Graphic GIS data used to determine existing coverage outside of HMR boundaries, per TRPA staff

Table C3: all sediment data for all alternatives by watershed (From Grismer, 2010)

Summary Table - SubWS # 7000

Yield

Parameter	AC Out-Proj	AC In-Proj	AC Total	Baseline	Out-Proj	IN-Proj	% Baseline	Proposed	Altern. 2	Altern. 3	Altern. 4	Altern. 5	Altern. 6
Sed (T/yr)	299.8	55.1	354.9	361.0	299.5	61.5	17.0	355.7	355.2	357.2	348.3	355.5	355.5
Silt (T/yr)	211.0	31.3	242.2	246.6	210.6	35.9	14.6	244.2	243.7	248.9	237.8	243.4	243.4
Clay (kg/yr)	510.6	293.3	803.9	838.1	510.5	327.6	39.1	803.3	799.2	748.7	756.9	808.1	808.1
Surflow (m3/yr)	1522283	90175	1612457	1612457	1522282.7	90174.6	5.6	1644505.6	1642348.7	1700348.0	1621353.8	1632742.3	1632742.3
Interflow (m3/yr)	4157272	313002	4470274	4470274	4157271.8	313002.2	7.0	4478886.8	4477995.3	4492360.2	4481839.9	4475425.7	4475425.7

Summary Table - SubWS # 7020 Madden

Yiled

Parameter	AC Out-Proj	AC In-Proj	AC Total	Baseline	Out-Proj	IN-Proj	% Baseline	Proposed	Altern. 2	Altern. 3	Altern. 4	Altern. 5	Altern. 6
Sed (T/yr)	649.8	434.7	1084.5	1036.0	577.1	458.9	44.3	998.6	1002.2	1002.2	957.4	1001.9	1001.9
Silt (T/yr)	416.3	270.7	687.0	641.2	351.3	290.0	45.2	611.7	614.6	614.6	578.6	614.5	614.5
Clay (kg/yr)	5409.9	3624.1	9034.0	8440.6	4433.0	4007.6	47.5	7880.6	7933.7	7933.7	7222.2	7932.5	7932.5
Surflow (m3/yr)	686901	390662	1077563	1077563	686901.1	390662.2	36.3	1046249.2	1093309.2	1093309.2	1090269.5	1093309.2	1093309.2
Interflow (m3/yr)	3015249	1365727	4380976	4380976	3015248.6	1365727.3	31.2	4251772.8	4257634.6	4257634.6	4274249.0	4251772.8	4251772.8

Summary Table - SubWS # 7030 Homewood

Yield

Parameter	AC Out-Proj	AC In-Proj	AC Total	Baseline	Out-Proj	IN-Proj	% Baseline	Proposed	Altern. 2	Altern. 3	Altern. 4	Altern. 5	Altern. 6
Sed (T/yr)	89.9	865.4	955.2	905.7	77.9	827.8	91.4	877.3	858.5	854.6	892.3	862.2	862.2
Silt (T/yr)	87.9	575.4	663.3	622.6	83.4	539.2	86.6	601.1	586.1	584.1	611.9	588.2	588.2
Clay (kg/yr)	588.1	8333.5	8921.6	8067.5	525.0	7542.5	93.5	7715.8	7428.4	7391.8	7911.8	7473.4	7473.4
Surflow (m3/yr)	96230	458234	554465	554465	96230.4	458234.4	82.6	561941.6	561941.6	571725.0	561812.3	549324.0	549324.0
Interflow (m3/yr)	375125	1747013	2122138	2122138	375125.3	1747013.1	82.3	2112953.2	2112953.2	2102810.4	2134104.0	2125346.7	2125346.7

Summary Table - SubWS # 7040 Quail Cr.

Parameter	AC Out-Proj	AC In-Proj	AC Total	Baseline	Yield Out-Proj	IN-Proj	% Baseline	Proposed	Altern. 2	Altern. 3	Altern. 4	Altern. 5	Altern. 6
Sed (T/yr)	314.9	147.2	462.1	408.9	256.7	152.2	37.2	407.6	405.9	405.9	392.5	405.9	406.4
Silt (T/yr)	199.0	86.7	285.7	239.7	149.3	90.4	37.7	238.8	237.5	237.5	227.8	237.5	238.1
Clay (kg/yr)	1996.7	1043.7	3040.4	2513.8	1408.6	1105.2	44.0	2511.1	2486.5	2486.5	2324.8	2486.4	2484.0
Surflow (m3/yr)	529345	166286	695632	695632	529345.4	166286.5	23.9	695420.6	695420.6	695420.6	695358.2	695420.6	695420.6
Interflow (m3/yr)	2212731	714372	2927104	2927104	2212731.1	714372.5	24.4	2929942.3	2927314.9	2927314.9	2928219.7	2929942.3	2929942.3
				1.3									

Summary Table - Overall four sub-basins

Parameter	AC Out-Proj	AC In-Proj	AC Total	Baseline	Out-Proj	IN-Proj	% Baseline	Proposed	Altern. 2	Altern. 3	Altern. 4	Altern. 5	Altern. 6
Sed (T/yr)	1354.4	1502.4	2856.8	2711.6	1211.2	1500.4	55.3	2639.2	2621.7	2620.0	2590.5	2625.5	2626.0
Silt (T/yr)	914.2	964.1	1878.3	1750.1	794.6	955.5	54.6	1695.8	1681.9	1685.1	1656.0	1683.6	1684.1
Clay (kg/yr)	8505.4	13294.6	21800.0	19860.0	6877.1	12982.9	65.4	18910.7	18647.7	18560.6	18215.7	18700.5	18698.1
Surflow (m3/yr)	2834760	1105358	3940117	3940117	2834760	1105357.7	28.1	3948117.0	3993020.1	4060802.7	3968793.8	3970796.1	3970796.1
Interflow (m3/yr)	9760377	4140115	13900492	13900492	9760377	4140115.1	29.8	13773555.1	13775898.0	13780120.1	13818412.5	13782487.5	13782487.5

Sed yield only (T/yr)

Watershed	**AC Out-Proj**	**AC In-Proj**	**AC Total**	**Baseline**	**Out-Proj**	**IN-Proj**	**% Baseline**	**Proposed**	**Altern. 2**	**Altern. 3**	**Altern. 4**	**Altern. 5**	**Altern. 6**
INT 7000	299.8	55.1	354.9	361.0	299.5	61.5	17.0	355.7	355.2	357.2	348.3	355.5	355.5
WS 7020	649.8	434.7	1084.5	1036.0	577.1	458.9	44.3	998.6	1002.2	1002.2	957.4	1001.9	1001.9
WS 7030	89.9	865.4	955.2	905.7	77.9	827.8	91.4	877.3	858.5	854.6	892.3	862.2	862.2
WS 7040	314.9	147.2	462.1	408.9	256.7	152.2	37.2	407.6	405.9	405.9	392.5	405.9	406.4
Total	***1354.4***	***1502.4***	***2856.8***	***2711.6***	***1211.2***	***1500.4***	***55.3***	***2639.2***	***2621.7***	***2620.0***	***2590.5***	***2625.5***	***2626.0***

Appendix D – TRPA Directives for Determination of the TOC

TAHOE REGIONAL PLANNING AGENCY
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MEMORANDUM

DATE: September 22, 2009

FROM: Scott Frazier, Soil Conservation & SEZ Program Manager

David Landry, Senior Planner

TO: David Tirman, Executive Vice President, JMA Ventures, LLC

SUBJECT: Threshold of Concern for Homewood Cumulative Watershed Effects Analysis

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Integrated Environmental Restoration Services (IERS), representative of JMA Ventures and Homewood Mountain Resort, submitted the first draft of the cumulative watershed effects (CWE) analysis for the Homewood Mountain Resort Ski Area Master Plan Project (Homewood Project) on May 5, 2009. After much review and discussion, the thresholds of concern (TOCs) contained in that draft report were determined to be inadequate by Tahoe Regional Planning Agency (TRPA) staff. The objective of this memorandum is to provide definitive guidance to JMA Ventures, LLC and IERS regarding the development of a scientifically valid and appropriate Threshold of Concern (TOC) for use in the Homewood CWE analysis. Some discussion of TRPA CWE analysis guidelines and work performed by IERS to date are provided here for context.

As you are aware, the TRPA Ski Area Master Plan Guidelines (Guidelines) require CWE analyses to evaluate the potential for proposed ski area master plan projects to contribute to adverse, cumulative effects on watershed conditions and water quality. The Guidelines require the use of a CWE analysis methodology that is based largely on the Equivalent Roaded Area (ERA) Methodology developed by Region 5 of the U.S. Forest Service (Region 5 USFS). The details of this methodology are described in the Guidelines and the Region 5 USFS Soil and Water Conservation Handbook (FSH 2509.22), but in general, the procedure involves four major steps: (i) characterize the natural sensitivity of each affected watershed and develop ERA-based thresholds of concern (TOC) that define or set limits on the "disturbance capacity" of each affected watershed, (ii) develop disturbance coefficients for each type of existing, proposed, and reasonably foreseeable land use or treatment in the affected watersheds, (iii) apply these disturbance coefficients to calculate an ERA value for each treatment or land use area, and (iv) compare the sum total of ERA values for each affected watershed to the appropriate ERA-based TOC. If existing ERA is equal to or greater the watershed's TOC, then cumulative watershed effects are likely and additional land disturbance is typically not permitted. If existing ERA is less that a watershed's TOC, then additional land disturbance up to the TOC may be permitted. Central to this procedure is the use of a quantitative TOC in gauging the potential for the proposed action to contribute trigger cumulative adverse effects on watershed conditions and water quality.

The ERA-based methodology described above has not yet been officially adopted by TRPA. The Guidelines state that until such a time as a CWE analysis methodology is formally adopted by TRPA, the agency may allow other methods for CWE analyses. In accordance with this clause of the Guidelines, IERS elected to use an alternative approach for the Homewood CWE analysis wherein sediment loading to surface waters, as predicted or "modeled" by the Loading Simulation Program in C++ (LSPC), was used as and indicator of cumulative watershed effects rather than

ERA. Joanne Marchetta, TRPA Executive Director, officially approved this alternative approach on April 24, 2009.

In their attempt to establish sediment loading-based TOCs for the three subject watersheds and one intervening area affected by the Homewood Project, IERS first looked at annualized suspended sediment data for the Homewood Creek and Madden Creek watersheds to gauge whether or not these watersheds are currently experiencing significant cumulative effects from existing development and disturbance. In general, the data showed no clearly degrading trend, which lead IERS to conclude that although the Homewood and Madden Creek watersheds are experiencing some adverse effects from existing development and disturbance, individual development and disturbance activities have not yet combined to trigger significant, irreversible cumulative effects on watershed conditions and water quality. Based solely on this limited amount of annualized water quality data, they deduced that the TOC for the Madden and Homewood Creek watersheds has not yet been exceeded, but that it was not possible to establish scientifically valid, sediment loading-based TOCs for these watersheds. Similar conclusions were drawn for the Quail Creek watershed and Intervening Area #7, although no suspended sediment data are available for these areas. Instead, they proposed using LSPC-predicted sediment loading rates for the baseline project alternative (i.e., current day conditions) as a kind of conservative, default TOC, and focused on using the LSPC model outputs as a tool for comparing the relative effects of the proposed action alternatives.

The use of modeled baseline sediment loading rates as the default TOCs for the subject watersheds and intervening area is convenient for the proposed project, as all of the action alternatives propose to improve watershed conditions and decrease sediment loading. However, this approach has no scientific basis, and suggests that any further disturbance or development that occurs after the proposed master plan project is implemented would trigger significant cumulative effects on watershed conditions and water quality. In addition, the annualized suspended sediment data presented by IERS do not necessarily reflect peak sediment loading rates, and by themselves, are not sufficient to establish that TOCs for the subject watersheds and intervening area have not yet been exceeded as the result of existing development and disturbance. For these reasons, TRPA staff have determined these methods are insufficient to establish valid and defensible TOCs for the subject watersheds and intervening area, and are requesting the following additional analysis be conducted and incorporated into the Draft Homewood CWE Report:

1. Compile existing data and information to characterize the overall condition of the subject watersheds and intervening area (e.g., channel conditions, mass wasting, accelerated hillslope erosion). These data and information on watershed conditions should be used in combination with available water quality data to substantiate the IERS interpretation that significant, adverse cumulative watershed effects have not already been triggered by existing development, disturbance, and land management activities.

2. Establish quantitative, sediment loading-based TOCs for each of the subject watersheds and intervening area by using LSPC to model sediment loading rates that would be expected if each subject watershed and intervening area contained the maximum allowable impervious land coverage established by Bailey (1974)[1].

[1] Bailey, R.G. 1974. Land-capability classification of the Lake Tahoe Basin, California-Nevada. U.S. Department of Agriculture Forest Service, in cooperation with the Tahoe Regional Planning Agency. South Lake Tahoe, CA.

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MEMORANDUM

DATE: November 24, 20~~10~~9

FROM: David Landry, Senior Planner, Environmental Review Services, TRPA Project Manager

TO: David Tirman, Executive Vice President, JMA Ventures, LLC

SUBJECT: Threshold of Concern for Homewood Cumulative Watershed Effects Analysis Final Direction Memorandum

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Background: As stated in the September 22, 2009 Memorandum from Scott Frazier TRPA Soil Conservation & SEZ Program Manager;

Integrated Environmental Restoration Services (IERS), representative of JMA Ventures and Homewood Mountain Resort, submitted the first draft of the cumulative watershed effects (CWE) analysis for the Homewood Mountain Resort Ski Area Master Plan Project (Homewood Project) on May 5, 2009. The thresholds of concern (TOCs) contained in that draft report was determined to be inadequate by Tahoe Regional Planning Agency (TRPA) staff. The objective of the September 22, 2009 memorandum was to provide definitive guidance to JMA Ventures, LLC and IERS regarding the development of a scientifically valid and appropriate Threshold of Concern (TOC) for use in the Homewood CWE analysis.

CWE Approach:
After lengthy discussions on the topic, it was decided by TRPA Scott Frazier TRPA Soil Conservation & SEZ Program Manager; Heather Gustafson, TRPA Senior Planner - Land Capability Program Manager, and David Landry, Senior Planner, Environmental Review Services, TRPA Homewood Project Manager, and acknowledged by Integrated Environmental Restoration Services (IERS), representative, JMA Ventures and Homewood Mountain Resort that the agreed upon approach to the CWE analysis will be based on the following data collection methodology;

1. Verified Bailey Scores
2. The results of Land Capability Challenges (located primarily in the base mountain areas)
3. Bailey overlay map (to be adjusted with the Slope Phase analysis) in which the applicant JMA Ventures would be responsible for compiling and/or conducting the actual work.

It was decided that the Bailey overlay for these areas could be "refined" by adjusting the land capability lines based on slope phase. It was envisioned by TRPA Staff that the applicant would obtain the necessary topographic information; (possible source, USGS and/or aerial photographic data) and then do a CAD analysis to breakdown the slope phases. The Bailey overlay could then be adjusted accordingly. The result would be a more accurate estimate of the land capability for the Homewood area. As a cautionary note, the results of this exercise may not be used for any TRPA verified LCV under any circumstances.

Appendix E – Alternative TOC Determinations and Discussions of Utility for Future Modeling Efforts

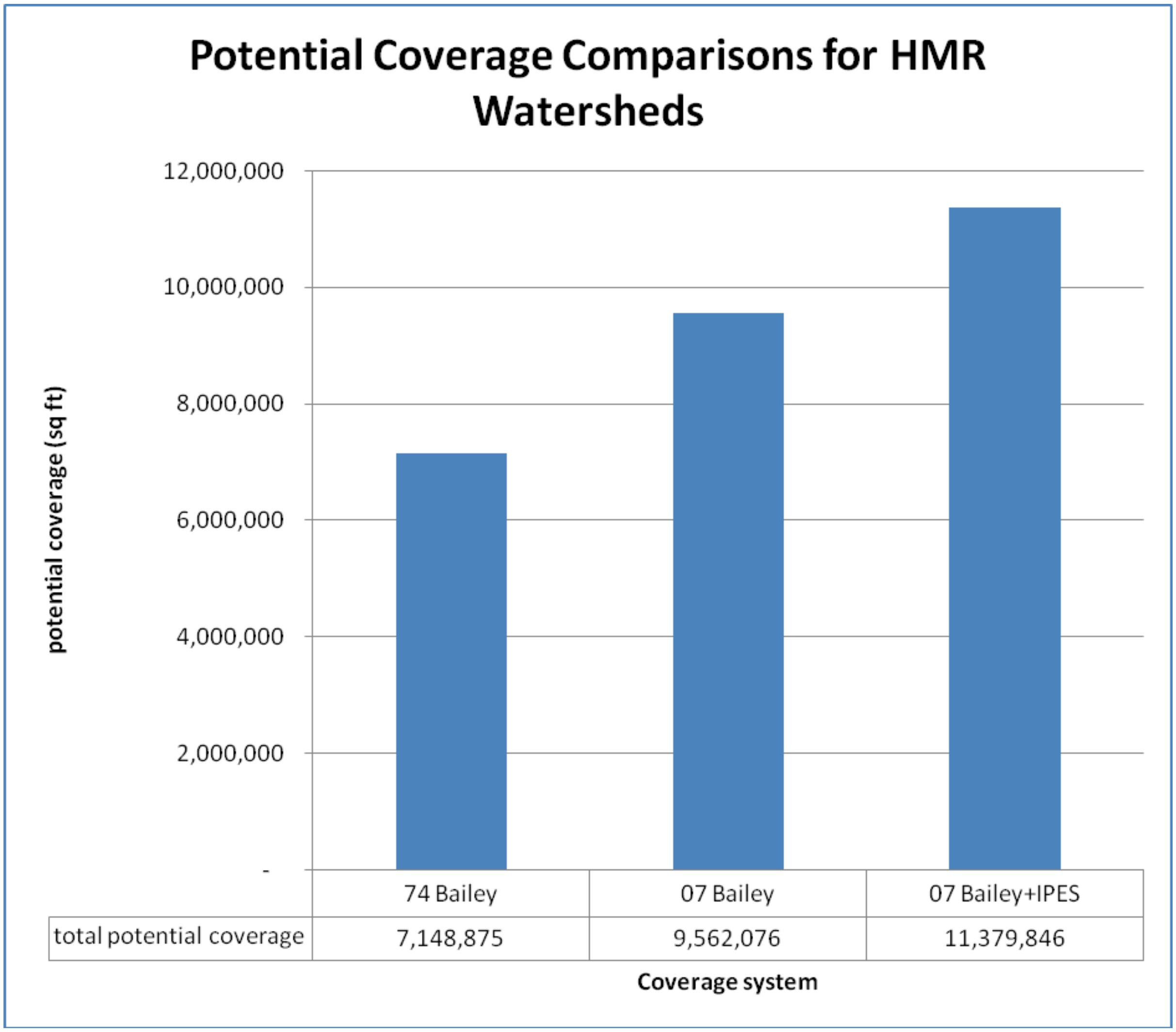

Figure E1: comparison of alternate coverage scenarios

Discussion

The graph and table presented above is the result of three coverage calculations developed as suggested by TRPA staff using different but arguably defensible alternate coverage calculations for the total watershed areas. This graphic is presented in order to show that the coverage system and associated assumptions used for this CWE study is one of three reasonable alternatives. As discussed in the body of this CWE report, we used the Bailey Land Classification System with associated 1974

Tahoe Soil Survey coverage coefficients. A more recent soil survey with a more accurate classification of soil types was used to determine what the total allowable coverage would be once that more recent information is used to update the Bailey coverage coefficients. One can see that this revision would result in approximately 1.4 million square feet of coverage in the 4 watersheds. Further, if the Homewood property were subdivided, using a combination of the updated Bailey Classification System and the more modern IPES system an additional 4.2 million feet of total watershed coverage would be possible. These data are presented in order to suggest that the current TOC would be significantly altered and increased under either of these scenarios. And while this CWE study was directed to use the currently accepted Bailey coefficients, future CWE studies on the same area would suggest that the TOC could be nearly 50% higher.

References for coverage values:

- Total existing verified land coverage **inside of project area**: TRPA land coverage values provided by Gary Midkiff from stamped TRPA table (Table 2, Boundary Line Adjustment, August 15th, 2008).
- Total existing land coverage area **outside of project area**: coverage calculations provided by Sid Davis from GIS data tables from TRPA. The project area was 'clipped' per watershed and land coverage for the remaining area was calculated See figure B1, in Appendix B.
- '74 Bailey allowable base land coverage: based on the Bailey LC polygons supplied by TRPA (adopted by Code), which were superimposed over the soil maps by Sid Davis to ascertain the pertinent soil map units (per Code language) and then appropriately adjusted for slope group of the appropriate SMU (1974 Soil Survey) as based on the USGS topographic maps (1:24000) per direction from TRPA staff. This includes allowable base land coverage inside the project area plus the additional land coverage from the land capability challenge recently approved by TRPA.
- '07 Bailey allowable base land coverage: provided by Sid Davis using the new soil survey and converting soil map units into Bailey Land Use Categories for allowable base land coverage based on those new map units.
- IPES inside project area: based on the August 15th, 2008 Boundary Line Adjustment Table 2 document from Gary Midkiff, which includes both allowable base land coverage and IPES scores that would be used if the resort is closed and the project area converted to private residences.